WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER
LOCAL PROTECTION

CONNECTICUT RIVER BASIN
HARTFORD, CONNECTICUT

DESIGN MEMORANDUM NO. 2

PHASE II

PROJECT DESIGN, SITE GEOLOGY AND INTERIOR DRAINAGE

PART I- BOX CONDUIT

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

AUGUST 1974

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED-E

30 August 1974

SUBJECT: Park River Local Protection, Connecticut River Basin, Hartford, Connecticut, Design Memorandum No. 2, Phase II - Project Design, Site Geology & Interior Drainage: Part I - Box Conduit

HQDA (DAEN-CWE-B)
WASH DC 20314

In accordance with ER 1110-2-1150, there is submitted herewith for review and approval Design Memorandum No. 2, Phase II - Project Design, Site Geology & Interior Drainage: Part I - Box Conduit, for the Park River Local Protection, Connecticut River Basin, Hartford, Connecticut.

FOR THE DIVISION ENGINEER:

Incl (14 cys)
as

JOHN Wm. LESLIE
Chief, Engineering Division

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION
CONNECTICUT RIVER BASIN
HARTFORD, CONNECTICUT

DESIGN MEMORANDA INDEX

Number	Title	Anticipated Submission Date	Date Submitted	Date Approved
1	Hydrology		16 Feb 73	12 Apr 73
2	GDM - Phase I - Plan Formulation		30 Mar 73	16 Jul 73
2	GDM - Phase II - Project Design, Site Geology & Interior Drainage			
	Part I - Box Conduit	Aug 74	30 Aug 74	18 Oct 74
	Part II - Auxiliary Conduit	Nov 74		
3	Hydraulic Analysis	Sep 74		
4	Concrete Materials	Jan 75		
5	Embankment & Foundations			
	Part I - Box Conduit	Jan 75		
	Part II - Auxiliary Conduit	Aug 75		
6	Pumping Stations	Oct 74		
7	Detailed Design of Structures			
	Part I - Box Conduit	Nov 74		
	Part II - Auxiliary Conduit	Aug 75		
8	Site Geology			
	Part II - Auxiliary Conduit	Feb 75		

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FOREWORD

PURPOSE. This memorandum is a functional design document concerned primarily with the technical design of the structures necessary to achieve the objectives previously approved in Design Memorandum No. 2 - Phase I - Plan Formulation.

SCOPE. In accordance with ER 1110-2-1150 duplication of data presented in the Phase I - Plan Formulation Memorandum has been minimized. This document includes the Phase II - Project Design, Site Geology & Interior Drainage for Part I - Box Conduit portion of the total project.

The remainder of the project will be presented in Design Memorandum No. 2 - Phase II - Project Design, Part II - Auxiliary Conduit.

For purposes of estimating the total cost of the project and computing the Benefit to Cost Ratio a brief resume of the work accomplished to date on the Auxiliary Conduit has been included in this part of the memorandum.

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION
CONNECTICUT RIVER BASIN
HARTFORD, CONNECTICUT

A. PERTINENT DATA

PURPOSE	Flood Control
LOCATION	
State	Connecticut
County	Hartford
City	Hartford
River	Park River & North and South Branch Park River
River Basin	Connecticut
PARK RIVER DRAINAGE AREAS	
Park River at the Mouth	78.7 Square Miles
North Branch Park River	27.7 Square Miles
South Branch Park River	47.0 Square Miles

RECORD OF MAJOR FLOODS

Year	Month	Peak Discharge, c.f.s. *
1936	March	5,400
1938	January	5,650
1938	September	5,320
1955	August	14,000
1955	October	6,420

*Gage at Riverside St. on Park River about 600 feet below junction of North and South Branches.

AREAS	
Subject to flooding, Acres	3,000
Inundated 1955 flood of record, Acres	2,300
Properties protected	Industrial, commercial, residential and public

TWIN-RECTANGULAR BOX CONDUIT

Material: Reinforced Concrete

Conduit Sections	Length in Feet	Half Section Width	Half Section Height
Existing (12,743 ft):			
Original (1944)	5,600	30'-0"	19'-4"
Section 1	1,213	34'-0"	26'-6"
Section 3	1,710	34'-0"	26'-6"
Section 6	1,460	36'-0"	27'-6"
Section 8	2,760	22'-0"	25'-0"
Proposed (4,036 ft):			
Section 2	1,232	34'-0"	26'-6"
Section 4	1,337	34'-0"	26'-6"
Section 5	103	36'-0"	27'-6"
Section 7	1,044	22'-0"	25'-0"
Section 9	320	22'-0"	25'-0"

AUXILIARY CONDUIT

Length, feet	9,100
Size, Inside Dia.	22'-0"
Material	Reinforced Concrete

CONDUIT CAPACITIES

North Branch (Sections 7, 8, & 9)	
Normal Flow Control	10,000 CFS
System Capacity Portion	7,200 CFS
South Branch (Sections 5 & 6)	
Normal Flow Control	22,000 CFS
System Capacity Portion	16,600 CFS
Park River (Sections 1, 2, 3, & 4, plus original 5,600 ft. length)	18,000 CFS
Auxiliary Conduit (22 ft. dia.)	5,800 CFS

SYSTEM DESIGN CAPACITY (Conn. River Stage of 30 ft. MSL)

Park River Conduit	18,000 CFS
Auxiliary Conduit	5,800 CFS
Total	23,800 CFS

HEADWALLS

South Branch (Existing):	
Elevation	54.5 MSL
Freeboard	2.5 ft
Ponding Level	52.0 MSL
Material	Reinforced Concrete
North Branch:	
Elevation	54.5 MSL
Freeboard	2.5 ft
Ponding level	52.0 MSL
Material	Reinforced Concrete

POPE PARK PUMPING STATION
(Formerly Riverside Pumping Station)

Location	Pope Park by Conduit Section 4
Capacity, cfs	75
Area Controlled, Acres	40
Runoff Controlled, inches per hr	1

ARMORY PUMPING STATION

Location	State Armory by Conduit Section 1
Capacity, cfs	120
Constructed by Others:	
Substructure, Approx. Size	70' x 90'
Sluice Gates, each	4
Flap Gate, each	1
Discharge Conduit	7' wide x 7' high
Gravity Conduit	8' wide x 7' high
Sluice Gates, each	2
Pumps, each	3
Superstructure, Approx. Size (L-shape)	50' x 57'-6"

LANDS AND DAMAGES

Lands Previously Acquired in Fee	9.50 acres
Permanent Easement	8.05 acres
Temporary Easement	28.39 acres
Building	Two level brick garage

PRINCIPAL QUANTITIES

Excavation, General	242,200 c.y.
Excavation, Rock	187,300 c.y.
Backfill Materials	358,000 c.y.
Concrete	170,000 c.y.
Steel Reinforcing	24,473,000 lbs.
Steel Bearing Piles	60,300 l.f.
Steel Sheet Piling	98,800 s.f.
Steel Tunnel Support	6,000,000 lbs.
Steel Rock Bolts	25,000 l.f.
Steel Lagging	40,000 l.f.
Steel Liner Plate-tunnel in earth	1,100,000 lbs.
Drainage Facilities	1 job
Seeded Topsoil	92,000 s.y.
Pumping Stations (2)	1 job

ESTIMATED PROJECT COSTS (July 1974 Price Level)

Lands and Damages	1,350,000
Relocations	950,000
Pumping Stations	800,000
Conduit Extension	24,700,000
Auxiliary Conduit	36,500,000
Engineering and Design	4,900,000
Supervision and Administration	4,100,000
Total First Cost	73,300,000

COST APPORTIONMENT

Federal	71,000,000
Non-Federal	2,300,000

ECONOMIC ANALYSIS

Annual Benefits	3,392,400
Annual Costs	2,689,000
Benefit-Cost Ratio	1.3 to 1

CONSTRUCTION PERIODS

Box Conduit	3.5 Years
Auxiliary Conduit	3.5 Years

B. LOCAL COOPERATION

1. VIEWS OF LOCAL INTERESTS. Meetings have been held with local officials to keep them advised as to the progress of the preliminary design of the project, to exchange ideas, and to keep them informed of the total estimated project cost and non-Federal costs.

The Court of Common Council of the City of Hartford has re-affirmed the intention and willingnesss of the City to cooperate and participate in flood control planning and works by the passage of a Resolution on 14 January 1974. A letter dated 4 February 1974 confirming this action and attested to by Robert J. Gallivan, City Clerk is included in Appendix A as Exhibit 1.

Asylum Hill, Inc. is an influential neighborhood improvement association which is concerned with the impact of the local flood protection project as it pertains to their area of interest. Mr. Jean R. Belair, Jr., Associate Director of the association has recently reviewed the current plans for the project with the City of Hartford Engineering Department. Their letter endorsing the project concept is included in Appendix A as Exhibit 2.

At a meeting of the Court of Common Council of the City of Hartford held on 12 August 1974 an Ordinance was passed by a vote of 7 to 0 authorizing $3,000,000 in municipal bonds to provide funds to meet the financial obligations of the City in accordance with the requirements of the Assurances. A copy of this Ordinance is included in Appendix A as Exhibit 3.

This Ordinance will require approval by the electors of the City in accordance with the provisions of the Charter of the City. Accordingly the Ordinance will be placed upon the voting machines as a bond referendum for the approval of the electors on 5 November 1974.

The Chief of Engineers will be notified concerning the returns for this Referendum as soon as official notification is received from the City.

2. LOCAL ASSURANCES. The conditions of the formal Assurances presented in Design Memorandum No. 2 - Phase I - Plan Formulation, page 51, paragraph 51 have been modified.

Condition "b" was modified in accordance with the Water Resources Development Act of 1974 which requires that the following words be added to condition "b": "except damages which are attributable to the fault or negligence of the United States or its contractors."

Condition "g." as presented in the Phase I - Plan Formulation Design Memorandum reads as follows:

"g. Provide without cost to the United States all alterations and relocations of buildings, utilities, highways and other facilities made necessary by the construction of the project."

This condition was added during the plan formulation stage and is not contained in the authorizing document. This condition has been deleted because it is in direct conflict with condition "d" of the authorizing document.

The revised conditions of the formal assurances are as follows:

a. Provide, without cost to the United States, all lands, easements, and rights-of-way required for construction and operation of the works, including lands for pumping stations and spoil disposal areas;

b. Hold and save the United States free from damages due to the construction works, except damages which are attributable to the fault or negligence of the United States or its contractors;

c. Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army;

d. Upon completion of the conduit construction, replace pavements, sidewalks, drainage and other appurtenances, including those at Broad Street, Flower Street, Laurel Street, and Farmington Avenue, and bear the cost of removal, replacement, and modification to sewers, drains, utilities, or highways beyond the area required for excavation and construction of the projects;

e. Prevent changes in the headpool ponding areas which would decrease the effectiveness of the improvements and if ponding areas and capacities are impaired, promptly substitute equivalent storage capacity;

f. Undertake all practical measures to prevent pollution from entering the Park River conduit system; and

g. Comply with the requirements specified in Section 210 and 305 of Public Law 91-646, 91st Congress, approved 2 January 1971 entitled "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970."

A request for formal Assurances from the Greater Hartford Flood Commission and the State of Connecticut will be made after approval of the Phase II - General Design Memorandum - Part I Box Conduits. Construction of the Park River Local Protection Project will require non-Federal interests to furnish Assurances imposed by the authorizing legislation and current additional requirements satisfactory to the Secretary of the Army.

This office has been informally advised that if the electors vote favorably in the Bond Referendum on 5 November 1974 that it is the intention of the City to take the necessary steps to execute the Assurances in early November 1974.

The Chief of Engineers will be notified concerning the execution of the Assurances as soon as official notification is received from the City.

C. LOCATION OF PROJECT AND TRIBUTARY AREA

3. GENERAL. The Park River basin is located in the central part of Connecticut and drains a large portion of the metropolitan Hartford area. The watershed has a drainage area of 78.7 square miles and is roughly rectangular in shape with an average width in an east-west direction of 5 miles and an average length in a north-south direction of 16 miles. Elevations range from about 200 feet msl along the lower reaches of the basin to a maximum of about 900 feet along the western edge of the watershed. Most of the area, however, is below elevation 200 feet msl, with a rolling to hilly topography.

4. PARK RIVER. The Park River, located entirely within the confines of the city of Hartford, is formed by the junction of the North and South Branches. If flows in an easterly direction, discharging into the Connecticut River about one half mile upstream of the Charter Oak Bridge.

5. SOUTH BRANCH PARK RIVER. The South Branch, commencing at the confluence of Trout and Piper Brooks, flows in a general northerly direction and drains an area of 47.0 square miles south and west of Hartford. It is 3.4 miles long and has a slope of 3.5 feet per mile. Trout Brook, with an area of 19.6 square miles, originates in the Talcott Mountain range in West Hartford and Farmington. Piper Brook, with a watershed of 22.2 square miles, develops in the hilly areas of New Britain. Its two main tributaries are Mill and Bass Brooks with respective drainage areas of 5.6 and 10.3 square miles. In the tributary headwaters there are numerous lakes and swampy areas which have a considerable reducing effect on floodflows.

6. NORTH BRANCH PARK RIVER. The North Branch flows in a general southerly direction, is 5.3 miles long, has a slope of 9.2 feet per mile, and drains an area of 27.7 square miles west and north of Hartford. It is formed by the junction of Wash and Tumbledown Brooks. Wash Brook, with a drainage area of 5.7 square miles, drains the northern part of the basin and originates in the town of Bloomfield. Tumbledown Brook drains the western part of the basin and has an area of about 8.7 square miles.

There is one lake and several swampy areas in the basin but they have little modifying effect on floodflows in the North Branch.

D. HYDROLOGY

7. GENERAL. The hydrology for the Park River project was presented in Design Memorandum No. 1, dated January 1973. Hydrologic analysis for the project incorporated earlier studies and data developed by the Soil Conservation Service, the Greater Hartford Flood Commission and the Corps of Engineers. The Park River conduit sections now under design will complete a comprehensive plan of improvements whose initiation dates back to 1944. Completion of the improvements was deemed the most reasonable alternative for minimizing the probability of a disastrous flood in downtown Hartford, Connecticut. Hydrologic design criteria for the proposed improvements is comparable to that used in the design of adjoining improvements by others.

8. DESIGN FLOOD. The Park River improvements are designed for a flood with a peak combined (inflow) of 32,000 cfs to conduit headwater storage, a peak conduit discharge (outflow) of 23,800 cfs, and a resulting maximum headwater elevation not to exceed 52 feet msl with a coincident Connecticut River tailwater stage of 30 feet msl.

The design flood for the Park River was developed using derived unit hydrographs and the August 1955 storm rainfall, as experienced over nearby Westfield, Massachusetts transposed over the Park River Basin.

The design storm has a 48-hour total rainfall of 18.3 inches with an excess of 15.9 inches. In comparison, the Corps' standard project storm for the area would have a 48-hour storm total of 12.8 inches resulting in an excess of 10.4 inches. The adopted design storm rainfall was the same as that used by the Greater Hartford Flood Commission in the design of existing conduits in the area. Pertinent hydrologic data for the Park River is listed in Table 1.

TABLE 1

PARK RIVER
PERTINENT HYDROLOGIC DATA

DRAINAGE AREAS		
North Branch (sq. mi.)	27.7	
(at Albany Ave. Gage) (sq. mi.)	25.3	
South Branch (sq. mi.)	47.0	
(at Newfield Ave. Gage) (sq. mi.)	40.6	
Park River (sq. mi.)	78.3	
DESIGN FLOOD DISCHARGES		
North Branch at Gage (cfs)	9,400	
South Branch at Gage (cfs)	19,100	
Local 8.1 sq. mi. (cfs)	4,480	
Peak Inflow to Storage (cfs)	32,000	
Peak Park River Outflow (cfs)	23,800	
North Branch Conduit Discharge (cfs)		
Peak Flow (cfs)	7,900	
(Contribution to Park River Peak)	5,800	
South Branch Conduit Discharge (cfs)		
Peak Flow (cfs)	18,400	
(Contribution to Park River Peak)	18,000	
DESIGN FLOOD LEVELS		
Headwater Storage Elevation (ft. msl)	52	
Connecticut River Tailwater Elevation (ft. msl)	30	
FLOOD OF RECORD DISCHARGES		
Park River (cfs)	14,000	(1955)
North Branch (cfs)	10,000	(1955)
South Branch (cfs)	5,000	(1955)
RECORD STORM RAINFALL (inches)	9.47	(1955)
DESIGN STORM RAINFALL (inches/48 hrs)	18.3	

9. HYDRAULIC ANALYSIS. Hydraulic analyses were performed to determine the size of the Park River conduit sections required to convey the design discharges. Hydraulic and energy grade lines and velocities for the design flow conditions and for a range of flow rates and Connecticut River tailwater levels were determined both manually and with the aid of computer program HEC 2, "Water Surface Profiles", developed by the Hydrologic Engineering Center, Davis, California. These data were employed in the development of discharge rating curves for the major elements of the system, namely the main conduit, North and South Branch conduits and the auxillary conduit.

A Manning "n" value of 0.013 was used to compute energy losses due to frictional resistance while bend losses were computed using coefficients of velocity head ranging from 0.01 to 0.09, depending upon bend radius and deflection angle. Entrance and exit losses were estimated to be 0.3 and 1.0 times velocity head, respectively, and loss due to contraction of area was computed using a coefficient of 0.2 applied to the change in velocity head across the transition. Energy losses through the junction structure were determined by hydraulic studies performed on a physical model of the conduit system at the Alden Research Laboratories of the Worcester Polytechnic Institute, Holden, Massachusetts. In addition to the evaluation of energy losses, the model study revealed the need for an air vent to be located on the South Branch conduit just upstream from the junction structure.

Under the design flood flow and tailwater condition, the entire conduit system (main stem and both branches) will be operating under pressure. Velocities are 5 fps and 9.5 fps in the North and South Branch, respectively, and 10.5 fps in Sections 2 and 4 of the main stem conduit.

The results of the detailed hydraulic analysis and model study will be presented in feature Design Memorandum No. 3, Hydraulic Analysis.

10. STREAMFLOW MANAGEMENT DURING CONSTRUCTION. Provisions have been made in design for handling riverflows during the construction of all conduit sections. The sizing of diversion facilities was based on the degree of risk and damage potential involved if the capacity of the diversion facility was exceeded. In most all cases the damage potential would be limited to that resulting from the flooding of the construction site. Diversion facilities and cofferdams will be designed to safely pass and protect against a moderate flow with some degree of accepted risk. Secondly, the facilities will be designed so as not to be a major obstruction to flows in the event of a large flood during construction. The construction area will also be kept free of unused materials and equipment that might obstruct flow in the event of a flood.

Peak discharge frequencies, both annually and seasonally, for the Park River and its branches are listed in Table 2. Frequencies were based on analysis of 25 years (1936-1961) of Park River discharge records at the former Riverside USGS gaging station, compared with observed peak flows on the branches during the past 10 years. Peak discharges on the branches during the past 10 years are listed in Table 3.

TABLE 2

DISCHARGE FREQUENCIES

	Park River (cfs)	North Branch (cfs)	South Branch (cfs)
ALL SEASON			
5-Year Frequency	3,700	1,600	2,100
10-Year Frequency	5,100	2,200	2,900
20-Year Frequency	7,000	3,100	4,000
MAY-OCTOBER			
5-Year Frequency	2,100	900	1,200
10-Year Frequency	3,800	1,600	2,200
20-Year Frequency	6,800	3,000	3,900
MAY-JULY			
5-Year Frequency	1,200	500	700
10-Year Frequency	1,700	700	1,000
20-Year Frequency	2,500	1,100	1,400

TABLE 3

PEAK DISCHARGES
(1963-1972)

	North Branch Gage at Albany Avenue (cfs)		South Branch Gage at Newfield Avenue (cfs)	
1963	520	March 6	902	October 5 (62)
1964	766	January 26	767	January 21
1965	890	February 25	1,580	February 25
1966	894	February 13	1,200	February 14
1967	610	April 18	420	April 18
1968	1,060	December 12 (67)	610	December 12 (67)
1969	1,220	March 25	1,230	March 25
1970	1,740	February 3	1,080	April 2
1971	484	February 27	730	February 27
1972	1,750	March 3	2,190	June 30

In general, the twin barrel conduits will be constructed in halves, therefore, once the initial barrel is completed it can serve for diversion while the second is completed. The principal facility for conveyance of flow during construction of the initial conduit will be a half circle corrugated metal flume 25 feet wide by 12.5 feet deep. This flume will provide a maximum capacity of about 2,000 cfs. It is contemplated that all phases of construction requiring use of the flume will be performed during the summer season when the frequency of high flow is at a minimum. Details of diversion and construction sequence are discussed in section H, "Construction Procedures and Diversion Plan".

11. ARMORY PUMPING STATION. Presently, there is a partially completed Armory pumping station located adjacent to the Park River conduit about 700 feet south of the downstream end of conduit section #2 and about 500 feet northwest of the State capital. Construction of the station by others was terminated pending completion of conduit section #2. In Park River Design Memorandum No. 2, Phase I, "Plan Formulation," it was recommended that construction of the Armory pumping station be completed at Federal expense as part of the overall Park River flood control project. The Board of Engineers stated agreement with the recommendation in their May 1973 letter to the Chief of Engineers.

During periods of high flow in the Park River, the station will pump drainage from: (a) about 15.5 acres of interstate highway and interchange area, (b) about 17.9 acres of highly developed area in the vicinity of, and including, the State Armory parking area, and (c) a 48-inch combined sanitary and storm sewer. Based on a hydrologic analysis of the area served, the design capacity of the station was reduced from 180 to 120 cfs. Pertinent hydrologic data used in arriving at the adopted capacity is listed in Table 4.

12. POPE PARK PUMPING STATION (Modified Riverside Pumping Station). The justification for the Riverside Pumping station, as proposed in Design Memorandum #1, was questioned by OCE in Indorsements 1 and 3. As a result of these comments and further study of the area, a modified design was developed and presented in Indorsement #4.

The modified plan consists of a pumping station for discharging interior runoff only from 40 acres of high damage area east of Sigourney Street. Pumping will not be provided, as was originally proposed, in the remaining 130 acres of interior area west of Sigourney Street.

The pumping station for the 40-acre area will have a capacity of 75 cfs, equivalent to the peak runoff rate from a 10-year frequency storm. Annual net benefits for the station were found to be maximized at a capacity of 75 cfs with a B/C ratio of 4.2. Pertinent data for this pumping station is given in Table 5.

13. LOW LEVEL DRAINS. The layout of the low level drainage system is shown on Plates 2A-14 and 2A-15. Design criteria is contained in Design Memorandum No. 1, HYDROLOGY, Par. 17, page 25. Briefly stated, the drains are sized to discharge the runoff from a 50-year frequency storm with gravity outfalls designed for a 100-year storm. All low level outfalls into the conduit will be gated.

For conduit sections 2, 4, and 7, runoff will be collected and piped parallel to the conduit on both sides of the conduit. At four locations (2 on each side) the drains will discharge into the conduit through structures that will permit positive closure of the drains. These discharge points will be located at Station 11+70 (Section 7) and Station 38+70 (Section 4).

TABLE 4
ARMORY PUMPING STATION
PERTINENT HYDROLOGIC DATA

Contributing Source	Drain Size at Station (in./diam.)	Drainage Area (acres)	Drain Capacity (cfs)	Storm Runoff Frequency (years)	Storm Runoff Discharge (cfs)	Control Grate Elev. (ft. msl)	Freq. of Required Pumping (years)	Selected Design Pumping Capacity (cfs)
Highway Interchange Area	48	15.5	65	5	28 (2)	24.7	5-10	33
				10	33			
				50	44			
				100	50			
Armory & Vicinity	36	17.9	50	5	41 (3)	40	100	47
				10	47			
				50	63			
				100	72			
Combined Sewer	48	Not Applicable	30 (1)	Not Applicable Full Capacity		30	20-30	30
							Total	110 cfs

(1) Limited capacity with existing 24-inch diameter siphon.
(2) T_c = 15 min. Rational "C" .5
(3) T_c = 20 min. Rational "C" .7

TABLE 5

POPE PARK PUMPING STATION
(MODIFIED RIVERSIDE PUMPING STATION)
PERTINENT HYDROLOGIC DATA

1.	DRAINAGE AREA	40 acres
2.	DRAIN SIZE AT STA.	72 inch Dia.
3.	DRAIN CAPACITY	140 cfs
4.	STORM RUNOFF (Tc = 30 min., Rational 'C' = 0.6)	
	5 yr. Freq.	62 cfs
	10 yr. Freq.	72 cfs
	50 yr. Freq.	95 cfs
	100 yr. Freq.	110 cfs
5.	CONTROL GRATE EL.	32 ft. msl
6.	FREQUENCY OF PUMPING	25 yrs.
7.	SELECTED DESIGN PUMP CAP.	75 cfs.

An inverted storm drain siphon will be installed at Station 20+80 (Conduit Section 2). This is made necessary by the low area on the north side of the conduit at this location. The area is too low (El. 32) to be drained eastward to the Armory Pumping Station and will be conveyed to the existing 60-inch drain on the south side of the conduit which will discharge into the conduit, by gravity, at Station 39+00± through a gate chamber. During high river stages this flow will be pumped by the new pumping station at Station 39+00. This pumping station will pump the runoff collected on the south side of the conduit from Station 9+00 to Station 38+00 and on the north side of the conduit from Station 17+00 to Station 21+00. Flow in the low level drain above Station 38+00 (south side of conduit) will be prevented from entering the pump station by an arrangement of gates. Discharge from the pumping station will be into the new conduit near Station 39+00.

In the vicinity of Farmington Avenue (Station 40+70±) there is an existing 36-inch drain on the west side of Park River and an existing 24-inch drain on the east side. Both of these drains collect runoff in Farmington Avenue and discharge it into Park River. Since the conduit prevents these pipes from being connected, it is proposed to discharge each pipe separately into the conduit through gate chambers which will provide both a flap gate and a sluice gate. This will give positive closure of these lines during high river stages.

In the area of the concrete flood wall, Station 42+65, there will be drainage pockets created on each side of the conduit which must be drained. Two solutions were considered. First, install drain inlets in the low spots and convey the runoff in a pipeline southward to the gate chambers mentioned in the paragraph above. It would be necessary to install these drain lines on piles due to the soil conditions in the area. For reasons of cost, this solution was rejected. The adopted plan provides for drain inlets in the low areas and gate chambers immediately adjacent to the inlets. This will permit normal drainage flow into the conduit and also provide positive closure during high river stages.

14. HIGH LEVEL DRAINS. The layout of the high level drainage system is shown on Plates Nos. 2A-14 and 2A-15. Design criteria is contained in Design Memorandum No. 1, HYDROLOGY, Paragraph 17, pages 28 and 29. The intent is to intercept as much drainage from a 25-year storm as is economically feasible before it flows into the low level area. This will be accomplished by constructing street inlets between curbs at intersections where there are heavy concentrations of surface flows.

Rim elevations for these inlets will be established by taking the elevation of the hydraulic gradient where the pipe discharges into the river conduit during design flood conditions and adding incremental losses for entrance and exit heads, pipe friction and some surcharges.

Discussion with city engineering personnel indicate that most of the drains in city streets are combination storm drains and sanitary sewers. They are old and overtaxed due to the substantial increase in population and built-over areas. For this reason, the pipe sizes for new pressure conduits will be designed to carry the 25-year flow alone.

The descriptions of the high level drainage areas is contained in Design Memorandum No. 1, HYDROLOGY, subparagraph 17c, page 26. These descriptions are updated as follows:

a. Subarea HL 1. This drainage area is divided into two parts by Farmington Avenue. Currently under construction is a 60-inch storm drain that begins at the intersection of Tremont St., and Farmington Avenue and terminates at the intersection of Farmington Avenue and the North Branch of the Park River. This pipe is designed to carry a 10-year storm and will take a 25-year storm with surcharge. There are two 18-inch sanitary sewers running parallel and on each side of the 60-inch line. It is scheduled for completion in December 1974. This pipe which will upon completion discharge into the Park River will be connected to the new conduit at Station 40+00.

The northern portion of the drainage area (HLIa) will have surface flows and storm drain laterals discharging into this new Farmington Avenue drain. The drain being replaced is a 30-inch combined sanitary and storm sewer. There is an existing 48-inch storm drain originating to the northwest that crosses the Tremont St. Farmington Avenue intersection and ties into the 8'-8" X 7'-0" conduit at the junction of West Boulevard and Sisson Avenue. This drain will be tied into the 60-inch Farmington Avenue line lessening the load on the Tremont St., drain downstream from this point.

The southern part of this drainage area (HLIb) is picked up by a system of combined sanitary and storm sewers and the downstream end of the Tremont St. drain. These lines discharge into the 8'-8" X 7'-0" trunk sewer that discharges into the existing Park River conduit at Station 27+00±.

No modifications are proposed for the existing high level drains in this area.

b. Subarea HL2. This drainage area has an existing 66 inch pressure conduit that discharges into the South Branch conduit. A street inlet between the curbing of Park St., east of its intersection with Orange St., will be installed to pick up surface flows that are not picked up by existing inlets during intense storms. There is an approximate 6 foot differential between the rim elevation of the inlet and the hydraulic gradient in the South Branch conduit during a design river flood.

c. Subarea HL3. An existing 24" overflow pipe in the Pope Park Pond carries drainage from the area to Park River through a gate chamber located just upstream of the proposed junction structure on the South Branch conduit. With a design river flood, the surcharge required to force a coincident storm into the conduit would overflow onto Park Street, and run into the low land drainage area. This will be remedied by constructing a dike in the overflow area allowing enough surcharge to accummulate to discharge a 25-year storm.

d. Subarea HL4. The overtaxed combination storm drain and sanitary sewers in this area allow substantial quantities of run-off to bypass existing inlets during moderate and intense storms. Topography indicates the heaviest concentration of these flows to be on Broad and Lawrence Streets. Two 48-inch pressure conduits with special street inlets (curb to curb) will be constructed on these streets with the rim elevations set to allow a surcharge build-up capable of discharging a 25-year storm into the new Park River conduit at the locations shown on Plate 2A-15. Similar arrangements will be made at the intersection of Capitol Avenue and Hungerford Street (42 inch pressure drain) and Babcock and Putnam Streets between Capitol Avenue and Russ Street (24 and 18 inch pressure drains).

e. Subarea HL5. This drainage area has an existing 42-inch pressure conduit that discharges into an existing section of Park River conduit. A street inlet will be installed near the intersection of Hawthorn Street and Sigourney Street to collect any runoff which bypasses the existing inlets.

f. Subarea HL6. There is an existing 66-inch pressure conduit that discharges into the existing Park River conduit. A street inlet will be installed near the intersection of Forest Street and Hawthorn Street to collect any runoff which exceeds the capacity of the existing inlets.

E. GEOLOGY AND SOILS

15. GENERAL GEOLOGY OF THE AREA. The project is located within the Connecticut Valley lowland an elongated basin of sedimentary rocks approximately 20 miles in width extending from Long Island Sound northward through the center of the State of Connecticut. The bedrock of the basin is of Triassic age and is comprised of conglomerate, shale and sandstone through which have intruded more recent sheets and dikes of basalt, a volcanic rock commonly called "Trap." The basin is bordered on the east and west by faults which separate it from the New England Upland an area of moderate relief comprised of maturely dissected resistant crystalline rocks. The relief of the basin is low except where faulting and differential weathering have left prominant ridges of resistant "trap" rock projecting above the valley floor. The general relief of the region presents a north-south trend which reflects the general strike of the trap rock ridges and of the sedimentary rocks which dip gently to the east.

The bedrock of the region is blanketed by glacial till which generally mantles the bedrock surface, occurring at the surface in the highest parts of the lowland. In the lowland areas the till is buried beneath extensive lacustrine deposits of stratified sand and varved silt and clay. These deposits, formed in glacial lakes generally having a spillway to the south produced a generally southward dip to the varved silt and clay deposits of the major valleys. These varved, fine grained deposits grade upward to silts and sands and become integral with the terraces of sands and gravels. The sand and gravel terraces formed in temporary lakes were controlled by the local spillways during glacial recession which in vicinity of the Park River in Hartford approximates elevation 45 M.S.L.

The subsurface water surface is controlled by the local stream gradient with the upper clay layer creating an impervious boundary which controls subsurface discharge and produces local slope failures. Poor drainage in tributary streams has been caused by local damming of drainage systems during glacial recession compounded by trap rock ridges which have interrupted the east-west stream development.

16. SURFICIAL AND SUBSURFACE INVESTIGATIONS.

a. Previous Investigations. Data from geological reconnaissances and test boring data provided by the Greater Hartford Flood Commission and Connecticut State Highway Department were presented in a report entitled "Report on Review of Survey for Flood Control Park River Basin," volume 11 dated July 1966. Location of previous borings pertinent to the present project are shown on Plates 2A-2, 2A-4, 2A-5, 2A-6, 2A-8, 2A-9, 2A-10 and 2A-11.

b. Current Investigations. Detailed geologic reconnaissances and twelve test borings were made in 1972 to 1973 along the presently proposed Box Conduit structures. A seismic survey was conducted in 1973 along

sections 2 and 9, to further define depths to bedrock and continuity of the clay and till surface on the slopes of Pope Park. One undisturbed boring has been made to obtain representative samples of the varved clays for testing. For locations of explorations and seismic lines see Plates 2A-2, 2A-4, 2A-5, 2A-6, 2A-8, 2A-9 and Appendix B for representative boring logs.

c. Future Investigations. Further investigations are planned in the area of the headworks structure and pumping station. The number and location of these borings will be determined during finalization of the design of the structures.

17. FOUNDATION CONDITIONS.

a. General. The Park River flows into the project area from the north over local alluvial features underlain by thick deposits of varved silts and clays. The typical geologic profile displays a variably thick deposit of compact glacial till intermediate to the clay and bedrock surface. Recent fills of variable composition are in evidence along the stream channel throughout the project area. The thickness of the overburden deposits thin rapidly to the south and east becoming conformable with the bedrock surface at the easterly limits of the project. The depth to the water table throughout the limits of the project is generally less than 10 feet below the land surface during part of the year. A discussion of the geologic profile at the individual sections of work is as follows:

(1) Section 2 Sta 8+68 to Sta 21+00. Bedrock at the section varies between 0 and 20 feet M.S.L. and is overlain by a compact glacial till from 1 to 15 feet in thickness (see plate 2A-19). The bedrock consists of a moderately hard gently dipping red shale and sandstone. The bedrock surface has been variably eroded by the Park River and by natural excavations but in general presents a gently sloping bedrock surface of adequate bearing for support of the propped structures. A projected fault defined by the alinement of the basalt ridge at Zion Hill and previous borings made for a city tunnel intersects the project at the lower end of the structures in the vicinity of station 11+00. The fault projection trends northeasterly with the upthrown side of the fault to the southeast. There is no surficial evidence of the fault at the location of the project structures. High natural fills and buildings border the present stream channel on both sides.

(2) Section 4 Station 38+10 to Station 51+33. The bedrock surface dips to the north normal to the direction of the conduit section and presents an irregular surface along the alinement of the section between +5 and -5 M.S.L. On the easterly side the bedrock is overlain by a compact glacial till varying in thickness from 2 to 20 feet and is blanketed by a layer of soft varved silt and clay which continues up the slope above the cut bank of Pope Park (See Plate 2A-18). These upper slopes surficially display typical slide failures with numerous springs which have developed pronounced gullies normal to the stream.

The west side of the alinement consists of a compact glacial till overlying the bedrock surface and is mantled by recent fills. Seismic profiles supplemented by borings have delineated the rock surface along the alinement profile and normal to the stream along the critical areas of slope stability. Bedrock throughout the section consists of a moderately hard red shale and sandstone generally unweathered except for localized weathering along open high angle joints. Thin calcareous coatings along the joints and calcite seams occur throughout the rock cores.

(3) Section 5, 7 and Junction Structure, Station 1+55 to 12+20. Geologic conditions applicable to the upstream limits of Section 4 are generally conformable with Section 5 except for the addition of a continuous thickness of soft silt and clay on the northeast side of the structure. A continuation of the compact till and soft silt and clay layer are relatively uniform in the downstream limits of the section. Beyond the mid point the bedrock drops rapidly with an increase in the thickness of the varved clay deposits. (See Plate 2A-17). The till mantle maintains a relatively uniform thickness averaging approximately 20 feet over the entire alinement with ground water surface throughout this reach approximating the stream gradient. The bedrock surfaces are moderately irregular with a gradual deepening of the rock from elevation 0 at the downstream limits to in excess of elevation -60 at the junction with existing Section 8. Fills of highly variable composition encroach on both sides of the present streams with thicknesses averaging from 15 to 20 feet.

(4) Section 9 Station 39+80 to 43+00. Northerly of Section 8 the bedrock surfaces as depicted by borings and seismic survey rises from elevation -90 at Farmington Avenue to elevation -60 approximately 800 feet north. The moderately hard red shale is overlain by thick deposits of compact glacial till as great as 45 feet and soft varved silt and clay to depths of 90 feet (See Plate 2A-16). The ground water surface approaches the natural stream gradient. Fill deposits of variable thickness blanket the soft silt and clay deposits. Bedrock in this section consists of a moderately hard red shale and sandstone with little surface weathering.

b. Soil and Rock Properties assumed for purpose of this design memorandum are discussed below. Foundation design will be submitted in detail in Design Memorandum No. 5 Embankments and Foundations, Part I.

(1) Varved Clay. The varved clay formation consists of alternate bands of clay (CH) and silt (ML). The thickness of the bands vary from paper thin to a few inches. Preliminary investigations show the following soil properties.

	Clay Bands	Silt Bands
Plasticity Index	30 to 45	5 to 15
Liquid Limit	50 to 75	35 to 45
Natural Water Content	60 to 70	40 to 50
Void Ratio	1.7 ±	1.2 ±
Specific Gravity	2.77 to 2.85	2.73 to 2.81

Visual inspection of samples from Corps borings done to date indicate that the percentage of clay bands vary from about 40 to 90 percent. "Undisturbed" sampling and testing of the varved clay will be done as part of the design effort schedule to be included in the embankment and foundations design memorandum.

(2) Till. The till consists of compact unsorted soil ranging from non-plastic gravelly silty sand to slightly plastic silty-clayey gravelly sand. Preliminary investigations show the following till properties:

Plasticity Index	Non-plastic to 5
Liquid Limit	20 maximum
Natural Water Content	7 to 14
Void Ratio	about 0.3
Specific Gravity	2.69 to 2.76

(3) Rock. The rock is a moderately hard red shale and sandstone. Bedding is not conspicuous but where discernible the dip is horizontal to 10°. Preliminary investigations indicate the following rock properties:

Compressive Strength (75% sat.)	2000 p.s.i.
Sliding Friction on Natural Joint	$\phi = 10^{\circ}$ Avg.
Seismic Velocity- Upper layers	9-14,000 fps
Non Slaking	2 cycles

c. Box Conduit Foundation. The box conduit sections will be founded on till, rock, or on piles end bearing on till or rock. A pile foundation is provided where there is varved clay in the foundation.

(1) Section 2. The structure will be founded on rock or till. Limited reaches may require removal and concrete fill.

(2) Section 4. The structure will be founded on compact till or rock. Limited foundation reaches will require removal of soft clay and replacement with concrete fill.

(3) Sections 5 and Junction Structures. The foundation consists of 2 to 8 feet of varved clay overlying compact till. The till deposit is 10 to 25 feet thick and it overlies rock. The soft clay overlying the till will be removed and replaced with concrete fill. The structures will thus be founded on compact till.

(4) Section 7. The foundation consists of a soft varved clay layer 20 to 40 feet thick overlying compact till. The till deposit is 10 to 30 feet thick and it overlies rock. The structure will be founded on end bearing piles.

(5) Section 9. The foundation consists of a soft varved clay layer 50 to 90 feet thick overlying compact till. The till deposit is 10 to 50 feet thick and it overlies rock. The structures will be founded on end bearing piles.

18. SEISMICITY. The Hartford area is placed in the category of minor damage (Zone 1) according to the seismic risk map recently developed by the Environmental Science Service Administration and the Coastal and Geodetic Survey. According to Engineering Technical Letter No. 1110-2-109, dated 21 October 1970, hydraulic structures in Zone 1 will be designed to withstand earthquake accelerations of .05g. A single projected fault zone intersecting the project structures is discussed under Site Geology, Paragraph 17.a.(1).

F. OTHER PLANS INVESTIGATED

19. BOX CONDUIT. The Box Conduit portion of the project consists of the design of the remaining sections necessary to complete the project. Sections 2, 4, 5 and 7 connect existing sections of conduit to a predetermined grade and alinement.

The alinement of Section 4 was moved 20 feet toward the left bank. With the old alinement the distance from the bottom of the excavation to the top of the necessary sheeting for the right bank would have been approximately 30 feet. With the revised alinement the distance from the bottom of the excavation to the top of the sheeting will be reduced to approximately 15 feet. The revised alinement will reduce the construction problems in this reach, and make for safer construction operations.

The length of conduit Section 9 was decreased from 935 feet to 320 feet in accordance with the 2nd and 3rd Indorsements to Design Memorandum No. 2 - Phase I - Plan Formulation.

20. ARMORY PUMPING STATION. After hydrologic and interior drainage studies, the station capacity was reduced from 170 cfs to 120 cfs.

21. POPE PARK PUMPING STATION (formerly Riverside Pumping Station). This station was moved to the downstream end of Conduit Section 4. After hydrologic and interior drainage studies, the station capacity was reduced from 180cfs to 75 cfs.

22. AUXILIARY CONDUIT. The alinement of the tunnel portion of the Auxiliary Conduit has been revised. Two curves in the tunnel were eliminated and the tunnel now has a straight alinement. The length of the tunnel portion was reduced from 6,300 feet to 6,000 feet. The remainder of the alinement is under intensive investigation at this time and the results of the studies will be presented in Design Memorandum No. 2 - Phase II - Project Design - Part II - Auxiliary Conduit.

G. DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS

23. GENERAL. The recommended plan for completing the existing flood control project for Hartford, Conn. is shown on Plates 2A-1 through 2A-13, consisting of conduit extension Sections 2, 4, 5, 7, and 9; a Junction Structure, a Concrete Headwall at the entrance to Section 9 on the North Branch, an Auxiliary Conduit from the Junction Structure to the Connecticut River, the Armory Pumping Station and the Pope Park Pumping Station (formerly the Riverside Pumping Station).

24. CONDUIT EXTENSIONS. The conduit sections will be of reinforced concrete with all sections having twin-rectangular barrels. Sections 2 and 4 will enclose 2,569 linear feet of the Park River. Section 5 will be 100 feet in length on the South Branch and Sections 7 and 9 will enclose 1,364 linear feet of the North Branch of the Park River.

The inside dimensions of each barrel of the conduit for Sections 2 and 4 will be 34 feet wide and 26.5 feet high. Section 2 is shown on Plates 2A-10 and 2A-11 and Section 4 is shown on Plates 2A-8 and 2A-9.

Section 5 will have twin barrels with inside dimensions of 36 feet wide by 27.5 feet high as shown on Plates 2A-6 and 2A-7.

Sections 7 and 9 will have twin barrels with inside dimensions of 22 feet wide by 25 feet high. Section 7 is shown on Plates 2A-4 and 2A-5 and Section 9 is shown on Plates 2A-2 and 2A-3.

25. JUNCTION STRUCTURE. The Junction Structure shown on Plates 2A-6 and 2A-7, to be of reinforced concrete, will serve to combine the flows from the North and South Branches and distribute them to the Park River and Auxiliary Conduits and thence to the Connecticut River. A model study performed under contract with the Alden Research Laboratories, Worcester Polytechnic Institute to determine the size and shape and effects of structural obstructions to flow has been completed and incorporated into the design presented.

26. NORTH BRANCH HEADWALL AND PORTAL. A reinforced concrete headwall and portal will be constructed at the entrance to conduit Section 9, shown on Plates 2A-2 and 2A-3. A monolithic base will support cantilevered headwalls and a semi-circular low weir section portal with five

vertical trash bars spaced uniformly in plan along the weir. Extensions of the headwall both east and west will be reinforced concrete retaining walls and I-walls to high ground to either side of the conduit. The top elevation of the headwall and portal will be 54.5 feet msl. The same as that of the headwall constructed at the entrance to the South Branch conduit and will provide 2.5 feet of freeboard.

27. ARMORY PUMPING STATION. A pumping station for the discharge of interior drainage shall be provided on the left bank of the Park River adjacent to the completed conduit Section 1 and east of the State Armory. The existing substructure (previously constructed by the Connecticut State Highway Department at this location) will be integrated with new superstructure, pumps, interior drainage system, and necessary equipment to make a fully operational station. Three vertical, nonclogging, mixed-flow, volute type pumps each with a pumping capacity of 18,000 gallons per minute shall be provided to pump the anticipated maximum inlet flow to the station of 120 cfs. The pumps will be diesel driven through right angle gear units. Normal interior runoff would normally flow through the 7'x7' gravity conduit to Park River conduit Section 1. During river flood stages the runoff would be diverted through the pump station, by operation of sluice gates, and pumped into conduit Section 1.

28. POPE PARK PUMPING STATION (formerly Riverside Pumping Station). A pumping station for the discharge of interior drainage shall be provided in Pope Park on the right bank and adjacent to the downstream end of Section 4. Three vertical, nonclogging, mixed-flow, volute type pumps, each with a pumping capacity of 11,500 gallons per minute shall be provided to pump the anticipated maximum inlet flow to the station of 75 cfs. The pumps will be diesel driven through right angle gear units. Normal interior runoff would normally flow by gravity to conduit Section 4. During river flood stages runoff would be directed through the pump station and pumped into conduit Section 4.

H. CONSTRUCTION PROCEDURE AND DIVERSION PLAN

29. GENERAL. The Park River Local Protection project consists essentially of two main construction features; being, the Box Conduit and the Auxiliary Conduit. The Box Conduit feature includes Sections 2, 4, 5, 7, 9 and the Junction Structure. The Auxiliary Conduit includes a transition structure, a tunnel in rock and a tunnel extension by open cut. Each of the major features as well as their components contain certain conditions and restrictions which warrant an individual approach to the problem of construction and diversion. Sections 2 and 9 of the Box Conduit feature are isolated and lend themselves to different solutions. The Junction Structure and its appurtenant Sections 4, 5 and 7 are interrelated and must be analyzed as a unit. The Auxiliary Conduit is basically an independent element except for its tie in to the Junction Structure.

30. HYDROLOGIC CONSIDERATIONS. The hydrologic criteria utilized in the development of the diversion plan is presented in Paragraph 10 "Stream Flow Management During Construction." It is contemplated that all phases of construction requiring use of a flume for diversion will be performed during the summer season when frequency of high flow is at a mimimum.

31. SECTION 2. Section 2 serves to close the gap between existing completed Sections 1 and 3. This segment of Park River features a highly built up region with numerous buildings in the close proximity of the river channel. Two streets cross the river within the limits of Section 2. The river bottom consists primarily of bedrock or bedrock with shallow cover. The proposed plan of construction in this reach is detailed on Plates 2A-10 and 2A-11 and consists of three phases. Phase A entails building a longitudinal sandbag dike approximately along the channel centerline for the full length (1232 feet). River flows would then be diverted to the north half of the channel followed by the installation of anchored construction sheeting. The south half is then excavated to El. 11.5 as shown. A 25 ft. diameter semi-circular flume would be installed in the excavated area, properly braced and the river flows diverted into the flume (Phase B - Plate 2A-11). Once the diversion is completed, the north half of the box conduit is to be constructed. The water is then diverted through the completed half of the box conduit while the 2nd half of the conduit is built - Phase C.

32. JUNCTION STRUCTURE AND ASSOCIATED SECTIONS 4, 5 and 7.

a. Concept. The junction structure is the key to this segment of the project since the three sections and the auxiliary conduits radiate from this focal point (Plate 2A-1). Consequently, the construction and diversion focuses upon constructing the Junction Structure first followed by sequential construction of various segments as illustrated by Phases A through F on Plate 2A-13.

b. Phase A. Phase A focuses on construction of the Junction Structure which is to be initiated by constructing a diversion channel around and to the north of the structure site. The diversion plan will accommodate both the North and South Branches of Park River and will run through an existing parking lot. Once the diversion is completed braced sheet piling and soldier beams and lagging will be installed to encompass (3 sides) the general outline of the Junction Structure. A berm is to be constructed downstream of the structure to control backwater as well as to provide additional access to the construction site. Once inclosed the site is to be excavated to proper grade. The structure is then to be constructed in the dry as one complete unit after which the Contractors may proceed with Phase B.

c. Phase B. The construction emphasis will then shift to the southern half of the twin box conduit in Section 4. Stream control will be accomplished by means of a 25 ft. diameter semi-circular flume which will extend from the terminus of the existing Section 3 to approximately Sta. 51+00 at the Junction Structure. Once the stream control is effective the system of soldier beams and lagging is to be extended on the south side and parallel to the conduit. The channel will then be excavated to grade and the south half of the twin box conduit is to be constructed.

d. Phase C. After the southern half of Section 4 is completed (or concurrently) the southern half of Section 5 is to be built in a similar manner (Phase C). This is to be accomplished by extending the system of soldier beams and lagging on the south and by installing single wall sheetpiling on the north. The stream flow in the southern half of the existing Section 6 will be stopped by means of a sandbag cofferdam installed upstream. Once the site is isolated and free of water, excavation and construction will proceed.

e. Phase D. Upon conpletion of the southern half of the box conduit in Sections 4 and 5 the flow of water from the South Branch can be passed through by removing 2 sandbag cofferdams and by building 3 others in the locations shown in Phase D. One row of sheeting must also be moved from the center of the channel to the north face of the Section 5 channel. This will permit the completion of the twin barrel conduit in Section 5.

f. Phase E. Completion of Section 5 will permit the Contractor to proceed with the 2nd half of Section 4 i.e. Phase E. This is to be accomplished by (1) building a berm across the diversion channel in the vicinity of the Junction Structure, (2) removing 2 sandbag cofferdams noted in Section 5 and (3) by installing a sandbag cofferdam at the approach to the northern half of the conduit in Section 4. The flow from both the North and South Branches of Park River would then pass through the Junction Structure and into the south half of Section 4. The flume is then removed and the remaining channel is then excavated by means of an open cut (sloped bank). The northern half is then constructed except for 2 monoliths as shown.

g. Phase F. The sixth and final phase, Phase F, consists of building Section 7. It is contemplated that Section 7 will be built in whole units which can be accomplished by diverting the flow of the North Branch completely outside the limits of the structure. The diversion will utilize (reuse) the 25' diameter flume which is to be installed in open terrain on the north side. The flume is to discharge into the two incompleted monoliths of Section 4. Excavation for Section 7 will utilize an open cut (sloped embankment) on the north side

and soldier beams with lagging on the south side. Once Section 7 is essentially complete the flume will be removed and the two monoliths in Section 4 are to be completed as well as the flume tie in at the upstream end of Section 7.

33. SECTION 9. Critical features within Section 9 include buildings close to the river's edge, Farmington Avenue, utilities and poor foundation materials. The sequence of construction contemplates constructing the first three monoliths abutting the end of the existing Section 8. Once completed, the Farmington Avenue traffic and utilities will be temporarily bypassed over the 3 new monoliths. See Plates 2A-2 and 2A-3. Farmington Avenue bridge (existing) will then be removed and subsequent monoliths are to be constructed. During the process of constructing the monoliths in the region of Farmington Avenue new and permanent utility lines are to be installed. The Farmington Avenue roadway will then be rebuilt to its original alignment and the bypass eliminated. Construction of the monoliths in themselves, will have to be accomplished in halves as detailed on Plate 2A-3. Three rows of steel sheeting are contemplated which will provide a work area and a diversion area. Due to poor foundation material, the steel sheet piling is to be supported by intermittent vertical H-piles and horizontal wales. The H-piles are to be driven to till. Bracing between rows will be utilized to support the sheet piling horizontally and batter piles will be used to alleviate any unbalanced horizontal forces. Other structural features of Section 9, such as T-Walls and I-Walls, are considered "straight-forward" where control of water during construction is not considered a major problem.

34. AUXILIARY CONDUIT. Construction of the Auxiliary Conduit is essentially independent of the box conduits except for its tie in to the Junction Structure. Construction of the tunnel, as presently planned, will utilize a vertical shaft in the vicinity of Park Terrace and a ramp approach in the vicinity of Governor St. The tie in of the Auxiliary Conduit to the Junction Structure will not be accomplished until the auxiliary is essentially complete. Hence, flow diversion during construction is not considered a major problem except for the terminus of the auxiliary at the Connecticut River and the tie in at the Junction Structure. Construction procedures and diversion plans for the auxiliary conduit will be more adequately covered in the Phase II GDM for the Auxiliary Conduit due to be submitted in November 1974.

I. ENVIRONMENTAL ANALYSIS

35. ENVIRONMENTAL CHARACTERISTICS. The proposed project is located entirely within the city limits of Hartford, the capital and most populous city in the State of Connecticut. The natural environment has virtually disappeared as is the case in most similar areas. The

pavement, residences, office buildings, industrial and business structures, highways and coincidental appurtenances typify the urban environment present in any large city.

The Park River once flowed in an open channel through this urban environment. Some of the river was later inclosed in conduits. There now are gaps between the sections of conduit, allowing the river to flow through deep open channels. The river water is a very poor quality, degraded by factory discharges, surface runoff, debris and various pollutants. Seven children lost their lives in the open channel between 1942 and 1968. Existing conditions result in low aesthetic values and high hazard potential.

There is a reach of about 1,600 feet of open channel between completed conduit Sections 3 and 6 presently causing erosion and endangering a high river bank within the public Pope Park area and adjacent streets. The park has been closed to the public due to the hazardous conditions along the river bank.

At present, the reach of the North Branch Park River extending northward from the completed conduit Section 8 at Farmington Avenue is open and winding. It meanders through an area to the rear of several apartment and professional buildings. During times of high water, flooding occurs along this reach, with resulting erosion of streambanks. The stream bed and banks are a depository for rubbish and junk carried there by the stream and discarded by people. Consequently, the area is unsightly and a continual source of aggravation to the users of the adjacent land.

36. PROJECT IMPACT. The area involved in the Park River conduit project is already committed to urban uses. There is no possibility of a reversal of the urbanization process and a restoration of the natural environment which once characterized the area. However, it is possible to improve the aesthetics of the project area. An improvement will result from the elimination of unsightly and dangerous open channels, from project features of competent architectural and landscape design, and from the inclusion of public use features in the project wherever possible.

Indirectly, the project will have beneficial effects on the adjacent areas by providing an environment more conducive to businesses, recreation and residential uses because of the elimination of the open channels. It will be possible not only to reopen the park, closed down because of the conditions cited above, but also, it is intended to blend the park area with the project area. The local economy should benefit by the improved aesthetics in the area.

The pumping stations and headwall will be designed primarily according to the practical demands of the project but attention will be given to aesthetic details to provide architectural compatability with the surrounding area particularly in light of the urban environment.

The auxiliary conduit would be installed almost completely underground. Therefore, no impairment of the aesthetics of the area above the conduit is foreseen. The proposed network of conduits, coupled with the pumping stations and headwall would have several beneficial results:

a. Minimization of the danger of flooding in the low-lying areas of Hartford, the destruction of developed properties and the existing hazards to life.

b. An upgrading of the urban environment due to the elimination of the open channels.

c. The improvement of pedestrian traffic conditions with the addition of walkways and benches over the new conduits.

During project construction noise, increased siltation and dust resulting from moving equipment and traffic congestion will be minimized and controlled as much as possible. Mitigative measures will be specified to minimize adverse impact on the local environment.

The reach of the auxiliary conduit between the vicinity of Washington Street and Von Block Avenue has been realigned. This realignment will help to reduce open ditch construction on Wyllys Street thus reducing conflicts with local traffic and residential areas.

37. PUBLIC USE AND ENVIRONMENTAL ASPECTS. During Phase I studies and investigations, consideration was given to the possibility that certain areas along the conduit right-of-way could be developed for certain limited public use activities. The matter was discussed with city of Hartford officials, with the intent of determining the attitude of the city toward such public use development and also the status of land within the right-of-way with respect to present or future proposed uses. The attitude of the city officials was favorable, and it was found that certain project areas might be available for limited public use development.

The types of public use development under consideration are small sit-in and walk through parks and landscaped connecting walks adjacent to existing park areas and other similar development. Possibilities for such development are limited because of the need for committing available areas over the conduit to parking and other practical uses. The engineering necessities arising during final design of the conduit itself are also limiting factors; for example: the final cross sections of the right-of-way with the conduit in place; the depth of fill (including topsoil) over the concrete conduit; cross sectional slope steepness; and surface drainage requirements.

Topsoiling, seeding, and landscape planting will be an integral part of the design to insure that the completed project is as visually acceptable as possible. Special attention will be afforded the reach of the river extending northerly from Farmington Avenue, so that the completed project will be compatible with the adjacent apartment buildings and adjoining lands. The lands within the conduit right-of-way will be designed and landscaped for harmonious blending with the area.

J. CORROSION MITIGATION

38. CORROSION MITIGATION. The steel bearing piles in Sections 7 and 9 are the only metal materials imbedded in earth. These steel piles will be driven completely in undisturbed earth which consists of silt and clay and silty sand and gravel till. A soil sample was tested and found to have a Ph of 7.9. These materials are considered non-corrosive and further tests are not considered warranted. The piles will not be painted or otherwise protected. This action conforms to instructions contained in Guide Spec. CE 1409.

K. ACCESS ROADS

39. ACCESS ROADS. The entire project is in an urban environment. Access to the various construction areas will be from existing city streets. For this reason no access roads will be required.

L. CONSTRUCTION MATERIALS

40. MATERIALS FROM REQUIRED EXCAVATION. The materials from required excavation will consist of flood plain sand and silt, varved clay, till and rock. It is estimated that about one-half of the materials can be selected for use as backfill material.

41. SAND AND GRAVEL. Sand and gravel of suitable quality and gradation are available from commercial suppliers located within a 10 to 25-mile radius from the project site. Current construction experience in the area is to import bank-run sand and gravel from sources located in Granby, Simsbury, Manchester and Bristol, Connecticut. Processed sand can be obtained from commercial suppliers located within a 5 to 25-mile radius.

42. STONE. Quarried-rock and crushed quarry rock materials of suitable quality are available from commercial suppliers located in Newington, North Branford, Plainville and Wallingford, Connecticut, within a 5 to 35-mile radius from the project site.

43. CONCRETE MATERIALS. Three previously tested commercial aggregate producers are within a 25-mile radius of the project. Previously tested and approved sources as listed in TM No. 6-370 are as follows:

The Balf Company
Newington, Connecticut
Latitude 41° N Longitude 72° W Index No. 4
Angelo Thomasso, Inc.
New Britain, Connecticut
Latitude 41° N Longitude 72° W Index No. 15

Used at Hancock Brook Dam, Hancock, Connecticut.

Roncari Industries
East Granby, Connecticut
Latitude 41°N Longitude 72°W Index No. 17

Used at Bradley Field, Windsor Locks, Connecticut.

A detailed discussion of concrete materials will be submitted in Design Memorandum No. 4, Concrete Materials.

44. GOVERNMENT-FURNISHED PROPERTY. There will be no Government-furnished property to be incorporated in the construction project.

M. RESERVOIR CLEARING

45. RESERVOIR CLEARING. The North and South Branches of the Park River will provide local storage upstream of their respective headwalls. The local storage areas will require no reservoir clearing and are suitable for development as linear parks and green areas.

N. ENVIRONMENTAL QUALITY ENHANCEMENT MEASURES

46. ARCHITECTURAL DESIGN. Architectural design of structures and facilities required for this project will be based upon fulfillment of functional needs and consideration of the adjacent environment at the site of project features. The design will provide an aesthetic value best suited to preserving, maintaining, or enhancing the urban quality at the locale of the feature described. Although the major elements of the project will be concealed below ground, there are three (3) features which by the nature of their location, require a studied application of aesthetic criteria.

47. ARMORY PUMPING STATION. The Armory Pumping Station is to be erected at a predetermined site on foundations and underground facilities installed by the Connecticut State Highway Department. The location of the pumping station is within a complex of elevated highways which preclude observation of the structure except for one facade. The latter facade will be partially screened by a ramp and existing shrubbery, but is within unobstructed line of sight of the State Capitol, which is located at the crest of the hill overlooking the City of Hartford. Broad lawns and park adjoin the State Capitol.

The original design for the pumping station provided for a brick exterior with approximately 15 percent of the predominant wall glazed in industrial sash. As originally designed, the floor area is slightly oversized for the pumps and ancillary equipment now determined necessary. It is intended that the original column layout and building plan be utilized in the new design to take advantage of existing construction.

Exterior design of the pumping station will reduce the glazed area and provide for concealment of the mufflers and associated piping. The facades will feature red brick and concrete finish with aesthetic value achieved by utilizing monumental proportions of mass and aperture.

48. POPE PARK PUMPING STATION (Formerly Riverside Pumping Station). The Pope Park Pumping Station is to be located adjacent to the convergence of three city streets and the conduit alignment. The structure will be sited in a point of city park land which requires grade alteration (fill) in conjunction with the conduit construction. Well maintained apartment houses, residences and a school adjoin the park and streets on the East side of the site, and the tract on the opposite side of the conduit is a redevelopment agency area. Current planning for development of that area envisions multi-story apartment structures and landscaped grounds as a visual extension of Pope Park.

Facades of the pumping station will be constructed with red brick and concrete finish. Masonry "solar screen" walls will conceal external equipment to the maximum extent feasible and provide a measure of security. The structure will achieve aesthetic compatibility with its environs by a harmonious arrangement of the materials and with due consideration of the relationship to human scale. To facilitate integration with the park, selected plantings will be incorporated in the design.

49. HEADWALL AND INLET STRUCTURE. The Headwall and Inlet Structure near Farmington Avenue are sited in a residential area of small apartment houses at the edge of a natural tree-lined basin with the stream circling a large grass field with attractively detailed paved parking area and garden plots.

A large "housing for the elderly" facility overlooks the basin area. The upstream face of the headwall will supplant much of the vegetation, especially along the south quadrant of the vista from the facility. The downstream face of the wall will be at the rear of apartments and generally adjoining paved parking areas. The top of the conduit, and approximately eight feet of the wall projecting above, will be visible from the street.

Height and expanse of the headwall will project it materially into the environment and will require careful detailing to achieve a harmonious relationship. The area of greatest prominence, occurring at the intake structure, lends itself to a serpentine plan due to functional (hydraulic) considerations as well as aesthetic. To further improve the scale and visual impact of the conduit opening, the debris barrier will consist of concrete columns supported on the spillway monolith and capped with a concrete curved beam. In order to restrict pedestrian passage across the headwall, the wall will be extended vertically at selected locations to form barrier pillars. Horizontal projection beyond the wall line required for fence-type barriers is not desirable due to the adjoining land use.

Concrete finish on the downstream face of the flood wall and on the upstream face outboard of the barrier pillars will be Class B with textured form liner and feature strip detailing at selected locations. The remainder of the exposed formed concrete surfaces will have Class C finish, except for the formed portions of the spillway, which will have Class B finish.

50. PROVISIONS FOR THE HANDICAPPED. Provisions for the handicapped are not required at the pumping stations and headwall structure. Public access is not applicable and the City of Hartford does not foresee a need. Exterior work in areas of public use will reflect required criteria for handicapped persons as appropriate.

51. LANDSCAPE ARCHITECTURE. The landscape architectural features of the Park River Project will be oriented to development of an aesthetically pleasing environmentally functional atmosphere for a variety of inner city needs. For purposes of discussion, the Park River Project will be broken down and treated in terms of units. Each unit will be addressed in terms of project needs and related land uses. (reference Plate 2A-1)

Sections 1, 3, 6 and 8 of the conduit have been completed by the Connecticut Bureau of Highways and the City of Hartford. The Park River Local Protection Project currently under consideration will provide for construction of the following segments:

a. Unit I. The Armory Pumping Station structure will be located beneath the fork of the I-84 interchange in view of the State Capitol. The sheltered location created by the elevated highway system and the extremely limited area available for planting mandates that the aesthetic quality of this structure be developed architecturally.

b. Unit II. Section 2 of the project involves the installation of a double barrel underground conduit commencing at the Hartford Armory and extending 1232' upstream. The section of this conduit extending upstream from the present terminus of Section 1 to Flower Street will be considered as an extension of Bushnell Park. Conduit installation and grade changes will necessitate removal of a considerable amount of existing tree growth and shrubbery. Visual contact with the river which flows in a rather attractively defined rock channel will be lost. To mitigate these losses, a park type atmosphere will be developed by placing walkways, benches, plantings and lighting in a manner compatible to the conduit as well as the existing environment. Rampways in lieu of steps will be utilized at grade changes to accommodate the handicapped. Efforts will be made to transplant the ornamental plantings in the horticulturally groomed area in front of the Armory, if economically feasible. Several of the predominately larger trees may be able to be saved by the installation of properly drained tree wells. A trapezoidal shaped pool with a lineal pattern of water jets to provide a fountain effect is proposed as a central focal point in front of the Armory. The top of the conduit between Broad Street and Flower Street will be landscaped with plantings, lighting, benches, and a lineal walkway to provide a green strip for pedestrian access from the adjacent State office buildings and commercial district to the area in front of the Armory.

The remainder of Section 2 from Flower Street to the existing outlet of Section 3 is closely confined by the adjacent multi-story industrial structures. This area will be allocated to the development of off-street parking. The conduit and associated drainage structures will be designed in a manner that will not preclude the entrance of natural light through the low window openings of the adjacent industrial structures.

c. Unit III. Sections 4, 5, 7 and the Junction Structure will be treated as a unit for environmental purposes. The land area west of Section 4 and north of the Junction Structure and Section 7 has been designated for quasi-commercial residential development under urban renewal. Several multi-story apartment structures with an associated need of open space for relaxation and leisure time activities will be developed as part of the current proposal. Pope Park lies to the East of conduit Section 4 and south of the Junction Structure. Stately hardwoods with light under growth provide a natural setting for outdoor recreational enjoyment along a 1500' reach of the proposed conduit. Shaded walkways serve as an integral part of the green belt park system.

Construction of the conduit will disturb a considerable amount of the existing tree growth and ground cover. Additional grading will be required to accommodate surface runoff. Emphasis will be placed on design of a plant system that will affect a suitable transition between renewal development and the park area. Restoration of disturbed walkways with suitable connectors designed to provide convenient public access from developed areas to the park will be provided. Tree wells will be used to conserve existing tree growth where feasible.

A pumping station will be located in the Pope Park Area to discharge surface runoff from the park and adjacent areas of development. Plantings will be selected to create a visually pleasing harmonious relationship with the building components and surrounding environs.

Section 7 extending westerly from Laurel Street to the outlet of existing conduit Section 8 will be grassed. Extensive planting in this area is not envisioned.

d. Unit IV. Conduit Section 9 to and including the Farmington Avenue intake structure will be treated as the final unit. Farmington Avenue serves as a physical divider with respect to use and treatment. The protion of the conduit south of Farmington Avenue will be grassed to maintain continuity of open space associated with the adjacent Hartford Public High School Athletic Area.

The section of conduit north of Farmington Avenue lies in a neighborhood of mixed income apartment structures. A relatively new Federally subsidized multi-story apartment structure for the aged rises from high ground to the Northeast, An attractively landscaped cresent shaped parking area for this facility has been developed on the low lying land opposite the intake structure. The river banks are presently lined with native vegetation. Much of this vegetation will be destroyed by construction of the conduit and intake structure. The concrete headwall and intake structure will be architecturally treated to reduce the visual impact. Riprap along the upstream toe of the headwall will provide contrast in color as well as texture.

The area disturbed by construction of the conduit between Farmington Avenue and the headwall will be landscaped in a manner that will create a limited area for public use as well as enhance the visible features of the project structures. Plantings will replace destroyed vegetation. Walkways and benches will accommodate pedestrian access.

Plates 2A-20 and 2A-21 portray the considered landscape treatment of project areas.

O. REAL ESTATE REQUIREMENTS

52. HISTORICAL COSTS. Approximately 9.5 acres of real estate required within Sections 2, 4, 5 and 7, the Junction Structure and Pumping Station has been acquired by the Greater Hartford Flood Commission at a cost reliably reported at about $300,000.

53. SECTION 7. A recommended change in the plan for improvement of the alinement of Section 7 of the Conduit Extension necessitates acquisition of an additional area of about 0.27 acres of unimproved commerical land. The land is located along the westerly side of Park River opposite Pope Park.

54. SECTION 9. This section begins at a point just south of the Farmington Avenue Bridge in and along the river banks. It then crosses Farmington Avenue and runs in a generally northerly direction and terminates about 135 feet north of the Farmington Avenue Bridge. From this point north, the river will remain in its natural course. The conduit extension and training walls will traverse lands devoted to two expensive apartment complexes, and rear lands of modestly improved residential sites. Improvements required for project purposes in this alinement consist of a two-level brick garage, and one two-stall garage. This section is located in a desirable neighborhood which has been dominated by quality apartment house properties. In order to complete construction of the west bank training wall, it is planned to relocate a two-stall garage about 30 feet northwest of its present location.

55. AUXILIARY CONDUIT. The Auxiliary Conduit will be constructed beneath the rights-of-way of public streets and private lands. Where the subsurface conduit passes under 32 private ownerships, permanent easements will be secured. This segment begins at the junction of the Park River and its North and South Branches in the northeasterly portion of Pope Park. It will run by excavation and backfill grading in an easterly direction about 400 feet to the intersection of Park Street and Park Terrace, then tunneled about 3,200 feet in an easterly direction under the rights-of-way of Park Street, then again easterly beneath 32 privately-owned residentially and commercially improved properties, for about 2,700 feet to the westerly side of Governor Street. It is then planned to continue the conduit by means of open surface excavation through residentially and commercially improved lands for about 800 feet to Wyllys Street, continuing in an easterly direction on Wyllys Street about 700 feet to Charter Oak and Van Dyke Avenues. The lower end of the tunnel would pass under Interstate Highway 91 and an existing floodwall at the Connecticut River.

The alinement of the Auxiliary Conduit from Governor Street to the Connecticut River is under intensive study as are the tunneling methods to be employed. The recommended alinement and the Revised Real Estate Requirements will be presented in General Design Memorandum No. 2 - Phase II - Project Design - Part II - Auxiliary Conduit.

P. RELOCATIONS

56. RELOCATIONS. Construction of the sections of conduit extensions will require the removal of the Broad Street, Flower Street, Laurel Street and Farmington Avenue bridges. Upon completion of the conduit, the highway pavement, sidewalks, drains and other appurtenances will be replaced in the same general locations with the grades adjusted to meet the changed conditions. At a few locations, the drains, sewers, and utilities will be relocated outside the area required for construction of the conduits.

An attorney's report of compensable interests will be prepared and included as an appendix to Design Memorandum No. 2 - Phase II - Part II - Project Design - Auxiliary Conduit. This report will cover all aspects of the project including items for which the local interests are financially responsible as well as those items which are a Federal financial responsibility.

Q. COST ESTIMATES

57. FIRST COSTS. Unit prices used in estimating construction and relocation costs are based on average bid prices for similar work in the same general area, estimated at the July 1974 price level. Valuations of real estate are based on appraisals of properties at the site made during June 1974 and includes the additional costs for resettlement and acquisition as required under Public Law 91-646. The Construction cost of the Conduit Extension includes an allowance of 15% for contingencies. All other construction costs include an allowance of 20% for contingencies. Costs of engineering and design and of supervision and administration, are estimated lump sums based on experience, knowledge and evaluation of the site and project, and comparison with similar projects in the area. The total first cost of the project is estimated at $73,300,000. A summary of costs for project features and a detailed break-down of quantities and unit prices is included in Appendix C.

TABLE 6

COMPARISON OF ESTIMATES
(Amounts in Thousands of Dollars)

Project Feature	Proj. Doc. (Jun 66)	1st Bud. Req. (Jun 70)	Phase I (Jan 73)	PB-3 (Jun 73)	Current (Jul 74)	Change	
01. Lands & Damages	630.	880.	1100.	1170.	1350.	+ 180.	(1)
02. Relocations	170.	220.	500.	530.	950.	+ 420.	(2)
13. Pumping Plants	480.	650.	1400.	1400.	800.	- 600.	(3)
15.1 Conduit Extension	9400.	12900.	17500.	18000.	24700.	+ 6700.	(4)
15.2 Auxiliary Conduit	16360.	22200.	25300.	26100.	36500.	+10400.	(5)
30. Engineering & Design	2090.	2750.	3900.	3500.	4900.	+ 1400.	(6)
31. Supervision & Adm.	1970.	2500.	3300.	3800.	4100.	+ 300.	(7)
TOTAL COST	31100.	42100.	53000.	54500.	73300.	+18800.	(8)

(1) Based on current real estate appraisals.
(2) Based on more detailed design being accomplished in preparation of GDM.
(3) Capacity of pumping plants reduced.
(4) More detailed design refined requirements for control and diversion of water and removal and replacement of utilities.
(5) More detailed design of open cut portion of conduit and removal and replacement of utilities.
(6) Re-analysis of requirements; Federal pay increases; includes $300,000 for GSA rental previously in S&A
(7) Re-analysis of requirements; Federal pay increases; reduction due to adjustment of GSA rental.
(8) See "Change In Cost Estimate."

CHANGE IN COST ESTIMATE
FROM INITIAL REQUEST FOR
AE&D FUNDS 1 JUL 70 (FY 1972 BUDGET)

PARK RIVER LOCAL PROTECTION
HARTFORD, CONNECTICUT

1. Nature of Change: Cost increase

2. B/C Ratio: 1.3-Old(3-1/4%): 1.3-New (3-1/4% interest)

3. Date of Previous Estimate: 1 July 1970 in support of initial AE&D budget request (FY 1972 Budget)

4. Costs:

	Federal	Non-Federal	Total
Previous Estaimte	$ 41,000,000	$ 1,100,000	$ 42,100,000
Prive Level Increase	25,914,000	609,000	26,523,000
Other Changes	4,086,000	591,000	4,677,000
Current Estimate	71,000,000	2,300,000	73,300,000

5. Reason for Change: There has been no significant change in the scope of the project. The changes that have occurred are the result of more detailed design.

The current Federal cost estimate of $71,000,000 is an increase of $30,000,000 over the estimate of $41,000,000 submitted to OMB in June 1970 supporting the first budgeted request for AE&D funds for FY 1972.

This project consists essentially of reinforced concrete and will require large quantities of the following steel items: reinforcing, bearing piles, sheet piling, tunnel support, rock bolts, lagging, tunnel liner plate and various other steel items.

It is to be noted that during this time interval the Base Mill Prices of steel in carload lots has increased by the following percentages: Structural 57%, Reinforcing 82%, Sheeting 64%.

During the period January 1974 through July 1974, the Base Mill Prices have increased as follows: Structural 27%, Reinforcing 69%, Sheeting 47%.

Previously the Mills would give the Contractors a firm quotation at the time of bidding. Today, quotations are not given and orders for future delivery are accepted only on the basis of market price on the date of delivery.

As a consequence when submitting a bid on a fixed price basis all Contractors must include in their bid prices a contingency for future and essentially unpredictable increases in the price of steel. This, over, above and beyond the escalations and risks taken heretofore.

Under previous conditions adjustment for price levels using the ENR: Construction Cost Index, would result in an increase of 50% of the 1970 total project cost of $42,100,000 equal to $21,050,000. After adjustment for price levels the other changes would be $10,150,000. This would require a Post-Authorization Change.

An analysis of recent bids received indicates that current bidding practice produced a price escalation of 18% during the period June 1973 through July 1974 and a 63% escalation for the period June 1970 through July 1974.

On the basis of 63% escalation for the period June 1970 through July 1974 the adjustment for price levels amounts to $26,523,000 and the cost of other changes is $4,677,000. For this reason a Post-Authorization Change will not be submitted.

The $4,086,000 of Federal changes includes the approved addition of 320 feet of conduit in Section 9 and the removal and replacement of utilities in the excavation area, less the reduced cost of the Pumping Plants.

R. SCHEDULES FOR DESIGN AND CONSTRUCTION

58. SCHEDULE FOR DESIGN. The schedule for design is predicated upon two construction contracts; the first for the Pumping Plants and Conduit Extension with a construction start in the spring of 1976 contingent upon future appropriations. A separate contract for the construction of the Auxiliary Conduit could then be awarded approximately one year later.

59. DESIGN MEMORANDA COMMON TO BOTH CONTRACTS.

Number	Title	Anticipated Submission Date	Date Submitted	Date Approved
1	Hydrology		16 Feb 73	12 Apr 73
2	GDM-Phase I- Plan Formulation		30 Mar 73	16 Jul 73
3	Hydraulic Analysis	Sep 74		
4	Concrete Materials	Jan 75		

60. DESIGN SCHEDULE PUMPING PLANTS AND CONDUIT EXTENSION.

Number	Title	Anticipated Submission Date	Date Submitted	Date Approved
2	GDM-Phase II- Project Design, Site Geology & Interior Drainage Part I - Box Conduit		30 Aug 74	
5	Embankment & Foundations Part I - Box Conduit	Jan 75		
6	Pumping Stations	Oct 74		
7	Detailed Design of Structures Part I - Box Conduit	Nov 74		
	PLANS & SPECIFICATIONS*	Oct 75		

*It is estimated that with funds available in FY 75 the plans and specifications will be approximately 50% complete on 30 June 1975.

61. DESIGN SCHEDULE AUXILIARY CONDUIT.

Number	Title	Anticipated Submission Date
2	GDM- Phase II-Project Design Part II - Auxiliary Conduit	Nov 74
5	Embankment & Foundations Part II - Auxiliary Conduit	Aug 75
7	Detailed Design of Structures Part II - Auxiliary	Aug 75
8	Site Geology Part II - Auxiliary Conduit	Feb 75
	PLANS & SPECIFICATIONS	May 76

62. CONSTRUCTION SCHEDULE GENERAL. The box conduit feature and the auxiliary conduit feature are sufficiently different and independent such that construction could be initiated concurrently. The box conduit aspect in itself is fragmented such that the Contractor could initiate construction in 3 sections simultaneously. It is assumed that the box conduit will be initiated first and will run for a period of 4 construction seasons (3-1/2 years). The auxiliary conduit would commence approximately 1 year later than the box conduit and would run for a period of 3-1/2 years. The schedule as set forth herein is considered reasonable and one that takes into account economics such as reuse of flume, sheeting etc. The schedule also attempts to avoid using the flume as the means of flow control during the heavy runoff period in late winter and in early spring.

63. BOX CONDUIT AND PUMPING PLANTS. It is assumed that the contract will be awarded in the early spring of 1976, the 1st Construction Season. The phases of construction are briefly outlined below, whereas the details of construction are more clearly discussed in Section H, "Construction Procedures and Diversion Plan."

a. First Construction Season.

(1) Section 2: Contractor will first install the longitudinal sandbag cofferdam in early spring as soon as the river flows permit and will divert the flows to the north half of the channel. Excavation of the south half of channel and the installation of flume is expected to be completed

by early July. The Contractor will then excavate and construct the north half of conduit for the full length of Section 2. This may necessitate some winter concrete placement. The remainder of the winter season will be spent dismantling the flume and transporting it to Section 4.

(2) Junction Structure Complex: Concurrently with the start of construction of Section 2, the Contractor will initiate construction of the junction structure as early in the spring as possible. He will initiate work by excavating the bypass channel, installing the cofferdam and by excavating to grade within the cofferdam. The Junction Structure is then to be built and completed by late fall.

b. Second Construction Season.

(1) Section 2: With the water diverted through the completed half, the Contractor will then construct the north half of conduit. Upon completion of construction he will backfill, grade and finish as required.

(2) Junction Structure Complex: The Contractor will initiate construction (early spring) of the flume in the northern half of Section 4. Once diversion via the flume is accomplished the Contractor will excavate and construct the southern half of Section 4 (Phase B). Concurrently, the Contractor will also construct the southern half of Section 5 such that by the spring of the 3rd construction season water can be diverted through the southern half of Sections 4, 5, and the Junction Structure. During the winter season he will remove the flume in Section 4.

c. Third Construction Season.

(1) Junction Structure: The Contractor will excavate and construct the northern half of Sections 4 and 5. He will also proceed to install the flume in Section 7 in preparation for construction for the following spring.

(2) Section 9: Contractor will initiate construction by building the first 3 monoliths abutting existing Section 8. Once completed, the bypass is to be constructed and Farmington Avenue traffic is to be rerouted. The existing Farmington Avenue Bridge is to be removed and the conduit construction is to be resumed. Construction of the I and T walls are also to be initiated.

d. Fourth Construction Season.

(1) Junction Structure Complex: Construction of Section 7 is to be initiated and completed, the flume removed and the 2 monoliths in Section 4 completed. The area is to be graded, topsoiled and seeded followed by final cleanup.

(2) Section 9. The conduit and T walls are to be completed, the area is to be graded and landscaped.

64. AUXILIARY CONDUIT. A revised schedule for the design and construction of the Auxiliary Conduit will be submitted in General Design Memorandum No. 2 - Phase II - Project Design - Part II - Auxiliary Conduit.

S. OPERATION AND MAINTENANCE

65. OPERATION AND MAINTENANCE. Maintenance and operation of the Park River Local Protection Project will be the responsibility of local interests. An operation and maintenance manual will be prepared by NED prior to completion of construction. The manual will cover all elements of the existing and proposed works associated with the Park River Conduit.

T. RESERVOIR REGULATION

66. RESERVOIR REGULATION. The North and South Branches of the Park River will provide local storage upstream of their respective headwalls. The local storage areas will not require reservoir regulation because both intake structures are ungated.

U. BENEFITS

67. GENERAL. The City of Hartford, the most populous city in Connecticut, is the State Capitol and the financial and trade center of the state. With roots deep in both state and national history, it is one of the country's oldest cities and also one of its most attractive.

Having a 1970 population of 158,000, Hartford is the core city of an SMSA with over 660,000 people and registering as 49th in population of all the SMSA's in the country. The economy of the SMSA has a broad base in manufacturing and finance, especially insurance, and in per capita income it ranks sixth in the country. The SMSA has one of the faster growth rates in population in the country (about 2.5% compounded annually for the period 1950-1970) and is projected to continue to grow in both population and physical size.

68. LAND USE. Based on the 1970 Census, Hartford has a gross population density of 8,495 per square mile but the figure is misleading. With 2,765 acres of its area devoted to parks and 2,800 acres in the North and South Meadows area devoted to transportation, mixed government and commercial facilities, the true population density of the rest of the city is approximately 16,000 per square mile. With such densities, developable land is at a premimum and urban renewal, both public by the City's Redevelopment Administration and private under the auspices of major local banks and insurance companies, is a continuing process in Hartford.

The portion of the Park River Basin in which the authorized project is to be constructed is prime land for such redevelopment. Other than the flood problem the area has advantages which few other sections of Hartford can approach. Running westerly approximately a mile from the grounds of the State House to the confluence of the Park River North and South Branches and then extending about a mile on the North Branch and a quarter of a mile on the South Branch, the flood plain is currently given over to an aging mix of commercial and industrial properties. Located only a three or four minute drive from Hartford's Central Business District and served by Interstate Highway I-84 (across from the area at two locations) the area has a potential for much higher utilization of its land than is currently the case. Adding to its amenities the flood plain is bounded on the south by Pope Park, a large urban park of 73 acres. There are currently about 30 acres of cleared land (Underwood-Urban Renewal Area) abutting the park planned for early development by a private developer and the City's Redevelopment Authority.

69. FLOOD LOSSES. A review of flood losses of the Park River below the confluence of its North and South Branches and along the lower reaches of its branches was conducted in the spring of 1974. The review found that the largest single source of loss at the time of the report on which the project document is based, a large industrial plant (Underwood Company) has been razed. The tract of land on which the plant stood has been acquired by one of the state's largest real estate developers. The land is currently zoned for industrial development but both the developer and the City's Redevelopment Agency are trying to change the entire area to commercial zoning permitting high rise apartment development, shopping center type development, or a mix of the two. Firm plans for the area are not completed at this time.

The field review also found changes in use of two buildings and that another building has been razed and a new office building erected on its site with expanded parking facilities. Near the confluence of the North and South Branches a new shopping center of 9 acres has been constructed and is subject to floods rarer than the 25-year event. Total annual losses in the studied reaches of the river amount to $1,659,100 under 1974 conditions.

An analysis was made of the annual losses in the new 9 acre shopping center alone. Such annual losses amount to $95,700 or $10,630 an acre. It is realistic to assume that development in the Underwood-Urban Renewal area would have a loss potential at least equal to the shopping center, so that annual losses for the 30 acres in the area feasible for developemnt will amount to $318,900. Development is expected to start concurrently with the flood control project and be completed in 6 years, so that the average annual equivalent value of the loss with interest at 3-1/4% would be $293,900.

For the properties other than in the Urban Renewal area, the loss potential will increase with time as the forces of competition and the demand for land generated by the population densities previously noted will mean a constant up-grading of properties to attain highest and best use of the land. In the Connecticut River Comprehensive Report (1970) the growth in flood loss potential was equated to the growth in real income in the area. For the Connecticut portion of the basin, the average annual equivalent value of the growth in real income was a factor of 0.393 using an interest rate of 4-7/8%. With an interest rate of 3-1/4%, this factor would of course be higher in any event but the locational and amenity values of this area are, as previously notes, so high that a much greater growth factor is in order. Losses are projected to grow at a rate equal to 30% of the growth in personal income over the next 50 years.

Hartford is in the Water Resources Planning Area 107, Hartford-Springfield of the North Atlantic Regional Water Resources Study for which personal income has been projected in constant 1958 dollars from 1970 through 2020. This data used in projecting losses with an average annual equivalent value of the growth derived at 0.66 amounts to an increase in loss potential of $1,095,000. Total annual losses in the studied reaches of the Park River amount to $3,048,000 consisting of $1,659,100 to current development, $1,095,000 average annual equivalent losses due to future growth and $293,900 average annual equivalent losses to development in the Underwood-Urban Renewal Area.

70. BENEFITS. Annual benefits are measured by the difference between average annual losses under conditions without flood protection and those that would result under conditions expected over the project life after its construction. Closing the gaps in the existing conduit and provision of an auxiliary conduit 25 feet in diameter to carry the excess flows in the larger floods would accure flood damage prevention benefits annually of $2,746,500 consisting of $1,502,100 to present damages, $991,000 in average annual equivalent values due to projected growth and $253,400 in average annual equivalent value in the Underwood-Urban Renewal area.

As an index of the effects of floods exceeding the capacity of the existing conduit and flooding downtown Hartford, data was obtained from the Hartford Clearing House on the dollar volume of daily transactions. At the present time the daily clearings are in excess of $33,600,000.

A flood of a magnitude which exceeded the conduit capacity would take from 5 to 7 days to recede in the North and South Meadow areas of Hartford. Over and above the damages caused by the flood in the flood plain proper, there would be a large decrease in the business activity of Hartford because of the lack of access from the east of Hartford and the extreme congestion caused by the loss of use of the area's principal north-south route through the Meadows. This decrease would be directly measured by the clearing house receipts. While it is estimated that some 90 percent of the decreased activity would represent simply a deferral, the other 10 percent would be lost forever. Therefore, such a flood would cause business losses in Hartford of $16,800,000 to $23,500,000 over and above the losses in the flood plain. On an annual basis this amounts to $201,800. Construction of the auxiliary conduit would prevent these losses.

In the reaches of the stream between Broad Street and Capitol Avenue on the Park River and between Laurel Street and Interstate Route I-84 on the North Branch, the area over the conduit can satisfy an urgent need for parking for employees of the industries and commercial ventures along the river. This use is incidental to normal conduit usage. Over 10 acres of space formerly used for parking in this area has been taken by the State for construction of Interstate Route I-84. The State Highway Department and the Hartford-Traffic Commission have already entered into an agreement whereby space under the overpasses and interchanges on Route I-84 will be leased to the city on nominal terms and be adapted to parking. This will do little to alleviate the parking problem because of the various configurations and limited amount of such space. Moreover, the locations at interchanges and local street over-passes will aggravate the traffic problem on the local ways because of access and egress from the parking areas into congested traffic.

An investigation was made into the rate of annual earnings for parking space for several New England cities including Hartford, as a measure of the value of the parking space available on top of the conduit. Information was received from State and municipal authorities and private operators on rates of return from public metered lots leased and private operators and privately-owned and operated facilities. The annual rate varied from $ .50 a square foot for metered parking in a Boston suburb to $3.50 per square foot

for private lots in Boston. In Hartford, the net annual return per square foot for parking amounts to $1.15 under current conditions. There are 160,000 square feet of conduit surface on which parking will be available. The estimated annual benefit amounts to $184,000.

The total tangible annual benefits to the project amount to $3,132,300 based on the provision of a 25-foot diameter auxiliary conduit. Adjustments to estimated losses in the headpool areas were made to increase the storage pool elevation from 49.8 feet to 51.8 feet, mean sea level and provide a 22-foot auxiliary conduit. Negative benefits were derived and deducted from the $3,132,300. The adjusted total tangible annual benefits to the recommended project providing a 22-foot diameter auxiliary conduit amount to $3,076,200.

71. ADVANCED REPLACEMENT BENEFITS. Construction of the conduit will obviate the need for four existing bridges over the Park River and its North Branch at Broad Street, Flower Street, Laurel Street and Farmington Avenue. The estimated total replacement costs of the bridges is $2,292,000. The bridges have a useful life of 75 years and their remaining lives range from zero to 47 years. Their depreciated cost is $647,000. The annual savings to the City of Hartford at these four locations amounts to the amortized depreciated costs plus annual maintenance.

Amortized Cost: $647,000 x 0.03388	$ 21,900
Annual Maintenance: 4 x $2,000	8,000
Total Advanced Replacement Benefits:	$ 29,900

72. REDEVELOPMENT BENEFITS. Senate Document No. 97 of the 87th Congress directs that where areas have been designated as Redevelopment Areas by the Redevelopment Administration, the project benefits shall be considered as increased by the value of the labor and other resources required for project construction and expected to be used in project operations, project maintenance and added area employment during the life of the project to the extent that such labor and resources would - in the absence of the project - be unutilized or underutilized.

The City of Hartford has been designated as a Title IV Redevelopment Area under P.L. 89-136 by the Economic Development Administration of the U.S. Department of Commerce. A sizeable proportion of the construction industry's work force is unemployed and the project will draw its workers from this pool.

The records of this office indicate that on the average civil works project, the labor cost approximates 27 percent of total construction cost. It is noted that a large part of this project consists of a tunnel which normally requires a special work crew so the total cost is not to be used. However, only about half of the tunnel will be driven, the rest will be cut and cover or normal construction. The construction cost involved will therefore be $26,450,000 of normal construction and one-half of the $36,500,000 tunnel cost or a total of $44,700,000. The estimated labor component is 27 percent of $44,700,000 or $12,067,000.

It is regular practice for a Contractor to bring a skelton crew of his own men on to a job and fill the rest of his requirements from the local labor pool. It is estimated that 75 percent of the laborers will be locally hired for this project. While not all of the labor put to work will come from the rolls of the unemployed, the jobs that they leave will be filled by people from the unemployed or under-employed rolls so that the entire 75 percent is used. It is estimated that the work will take three years to complete. With interest at 3-1/4 percent the derivation of the annual redevelopment benefit is as follows:

$12,069,000 x .75 = $9,051,800
1st yr. $2,051,800 x PW_1 (.9685) = $1,987,150
2nd yr. $3,500,000 x PW_2 (.9380) = $3,283,000
3rd yr. $3,500,000 x PW_3 (.9085) = $3,179,750

Total P.W. $8,449,900

Annual Benefit = $8,449,900 x (CRF - 3-1/4% - 100 yrs.) .033883 =
$ 286,300

A benefit for unemployed labor put to work for maintenance and operation of the completed project is not claimed as the city will do this with their own regular force.

73. SUMMARY OF BENEFITS. A summary of the total average annual benefits creditable to the project for flood control based on completing the conduit extensions, a 22-foot diameter auxiliary conduit and appurtenant works, are set forth below:

Benefit Category	Amount
Flood Damages Prevented	$ 2,746,500
Business Activity	201,800
Parking Facilities	184,000
Total average annual benefits providing a 25-foot dia. auxiliary conduit	$ 3,132,300
Negative benefits based on estimated additional losses in headpool areas	-56,100
Adjusted total average annual benefits providing a 22-foot dia. auxiliary conduit	$ 3,076,200
Advanced Replacement of Bridges	29,900
Redevelopment Benefits	286,300
TOTAL AVERAGE ANNUAL BENEFITS	$ 3,392,400

V. COST ALLOCATION

74. SUMMARY OF FIRST COSTS.

Federal	$ 71,000,000
Non-Federal	2,300,000
	$ 73,300,000

The details of cost allocation are presented in Appendix C, "Project Cost and Estimates."

W. STATEMENT OF FINDINGS

75. STATEMENT OF FINDINGS. I have reviewed and evaluated, in light of the overall public interest, the documents concerning the proposed action, as well as the stated views of other interested agencies and the concerned public, relative to the various practicable alternatives in accomplishing local flood protection along the Park River and the North and South Branches in the City of Hartford, Connecticut.

The possible consequences of these alternatives have been restudied according to environmental, social well-being, and economic effects, including regional and national development and engineering feasibility.

I find this General Design Memorandum, Phase II - Part I - Box Conduit to be substantially in accord with the scope and intent of the project as presented in the previously approved Design Memorandum No. 2, Phase I - Plan Formulation.

JOHN H. MASON
Colonel, Corps of Engineers
Division Engineer

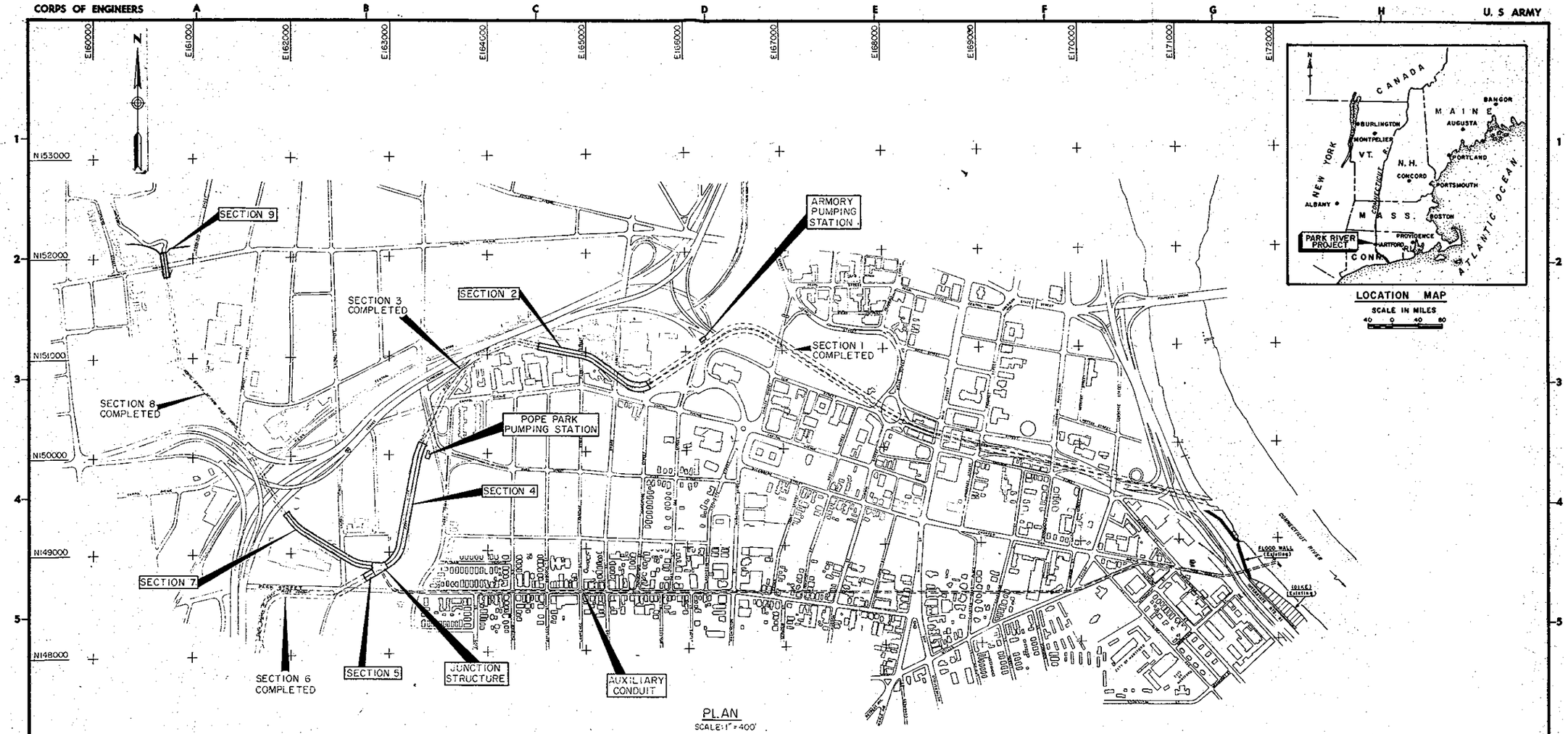
X. DELETED

76. DELETED. This section is deleted in accordance with ER 110-2-1150, Change 7, 22 July 1974.

Y. RECOMMENDATIONS

77. TREATMENT RECOMMENDED. It is recommended that the project plan, consisting of twin-rectangular conduit extension sections along the Park River, the North Branch and a short section on the South Branch; a junction structure; two pumping stations; a headwall and wingwalls on the North Branch; submitted in this memorandum, be approved as the basis for preparation of Detailed Feature Design Memoranda and contract plans for this, the Box Conduit Extension portion of the Park River Local Protection Project, Hartford, Connecticut.

CORPS OF ENGINEERS — U.S ARMY



PLAN
SCALE: 1" = 400'

LOCATION MAP
SCALE IN MILES
40 0 40 80

LEGEND

- ● 5 Greater Hartford Flood Commission Boring (1960-1963)
- ● FC3 Flood Commission Boring (1960)
- ● BHG Connecticut Highway Department (1959)
- ● FD5 U.S. Army Corps of Engineers Boring
- —— A5 Seismic Line
- W Water
- SD Strom Drain
- SS Sanitary Sewer
- G Gas
- E Electric
- T Telephone
- Bedrock Outcrop

GENERAL NOTES:

1. Elevations refer to Mean Sea Level Datum.
2. All elevations are plus except as noted otherwise.
3. Plane coordinates refer to Connecticut Lambert Grid System.
4. For Typical Explorations see Appendix B.

GRAPHIC SCALES
1"=400' 400 0 400 800

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED

CHIEF, SECTION
APPROVAL RECOMMENDED
CHIEF, TECH. ENG. BRANCH
RECOMMENDED
PROJECT ENGINEER
APPROVAL RECOMMENDED
CHIEF BRANCH

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
GENERAL PLAN
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 2A-1

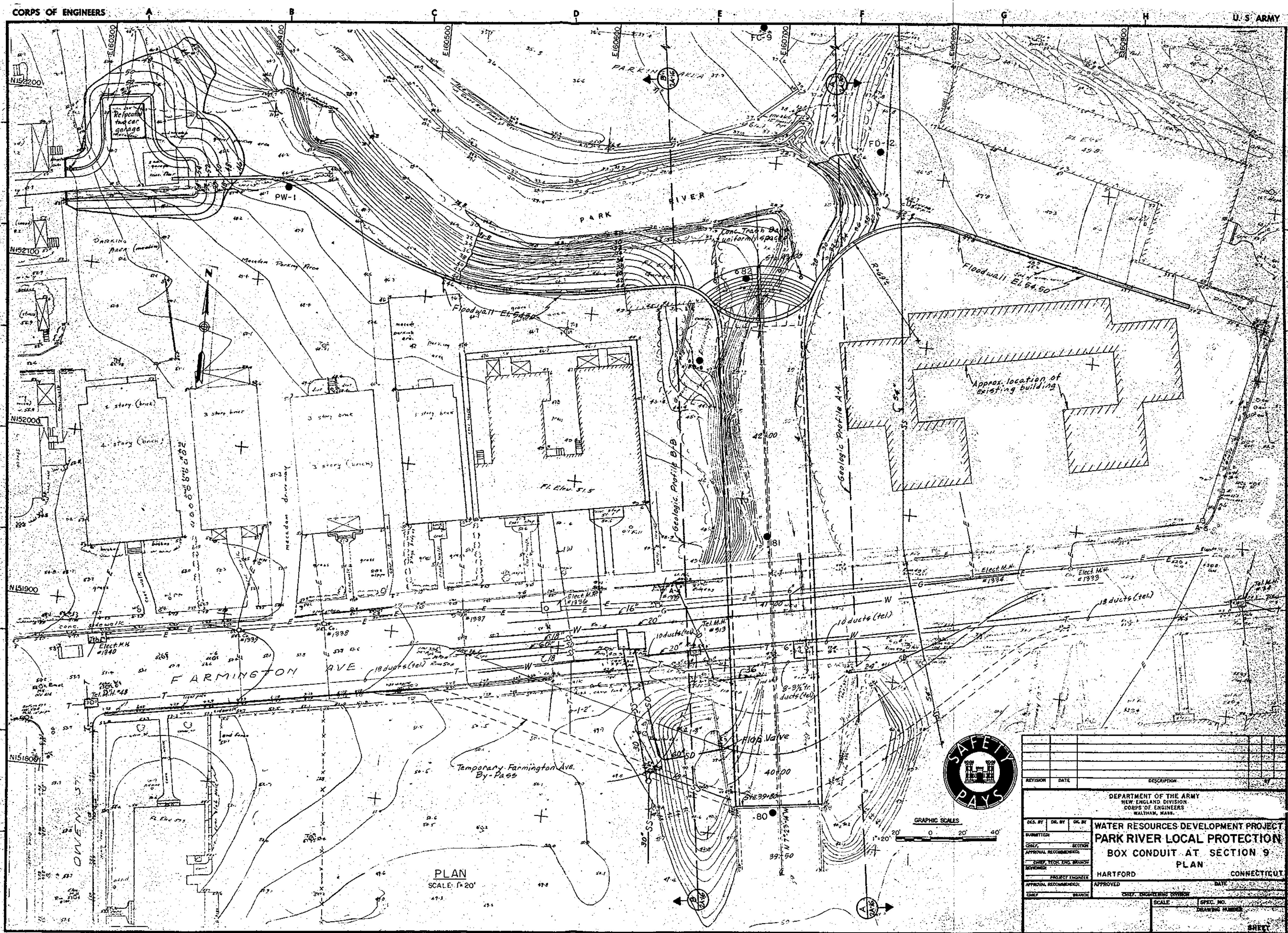
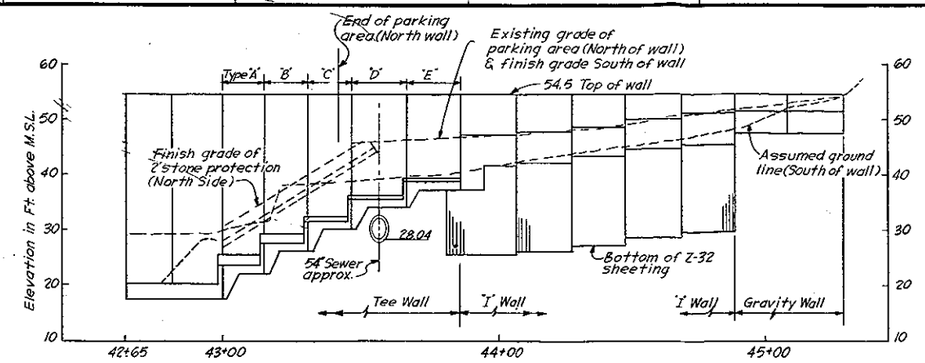
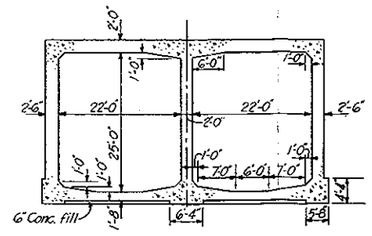

CORPS OF ENGINEERS
U.S. ARMY
PARK RIVER
PARKING AREA
Relocated two car garage
Macadam Parking Area
Floodwall El. 54.50
Approx. location of existing building
4 story (brick)
3 story (brick)
1 story brick
Fl. Elev. 51.5
Geologic Profile B-B
Geologic Profile A-A
FARMINGTON AVE
18 ducts (tel)
10 ducts (tel)
Flap Valve
Temporary Farmington Ave. By-Pass
OWEN ST
PW-1
FD-9
FD-12
PLAN
SCALE: 1"=20'
GRAPHIC SCALES
SAFETY PAYS
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
BOX CONDUIT AT SECTION 9
PLAN
HARTFORD
CONNECTICUT

PLATE 2A-2

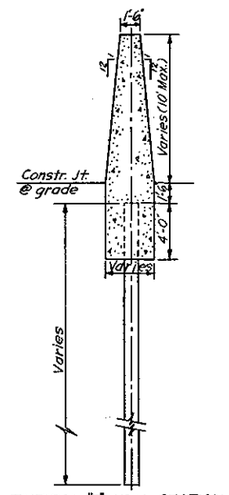
CORPS OF ENGINEERS — U. S. ARMY



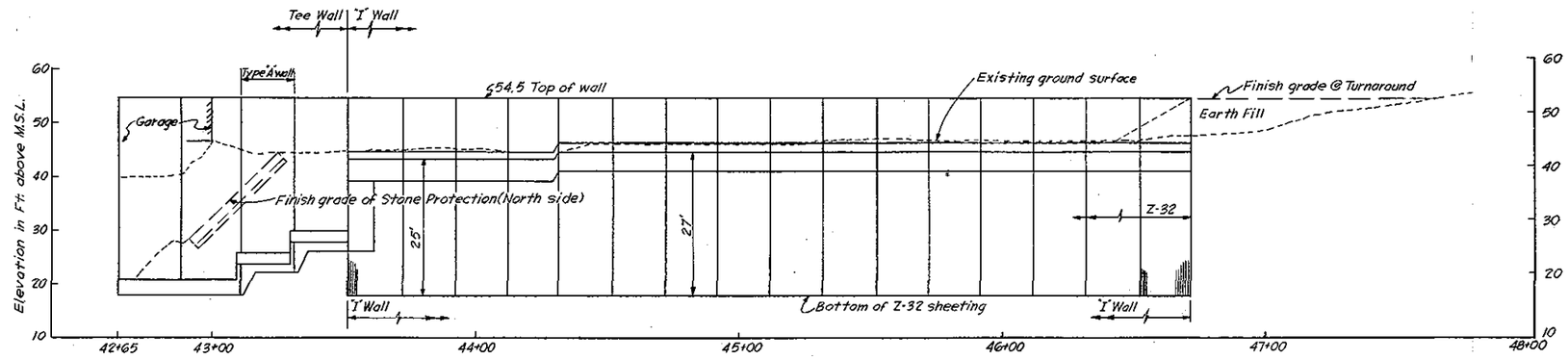
PROFILE EAST FLOOD WALL
SCALE HORZ. 1"=20'
VERT. 1"=10'



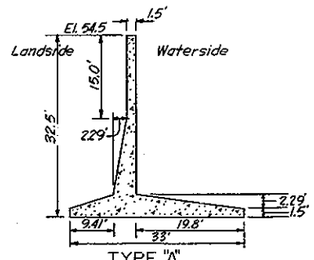
TYPICAL CONDUIT SECTION
SECTION 9
SCALE 1"=10'



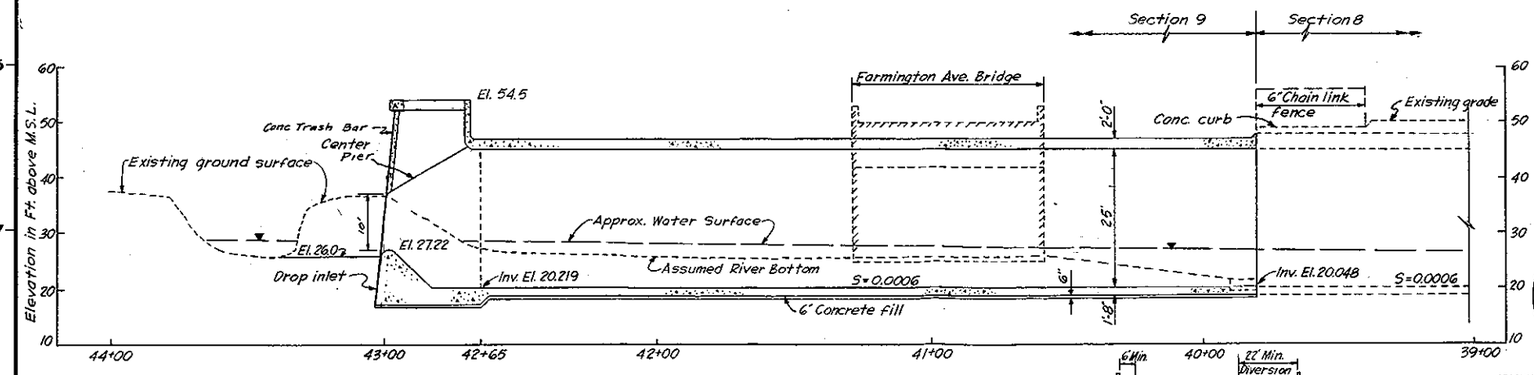
TYPICAL "I" WALL SECTION
SCALE 1/4"=1'-0"



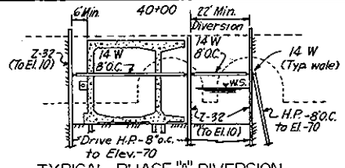
PROFILE WEST FLOOD WALL
SCALE HORZ. 1"=20'
VERT. 1"=10'



TYPE "A"
TYPICAL "TEE" WALL SECTION
SCALE 1"=10'



SECTIONAL PROFILE - SECTION 9
SCALE HORZ. 1"=20'
VERT. 1"=10'



TYPICAL PHASE 'A' DIVERSION
(SECTION 9 at Sta. 40+80)
SCALE 1"=20'

GRAPHIC SCALES

1"=20' 20' 0 20' 40'
1"=10' 10' 0 10' 20'
1/4"=1'-0" 4' 0 4' 8'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

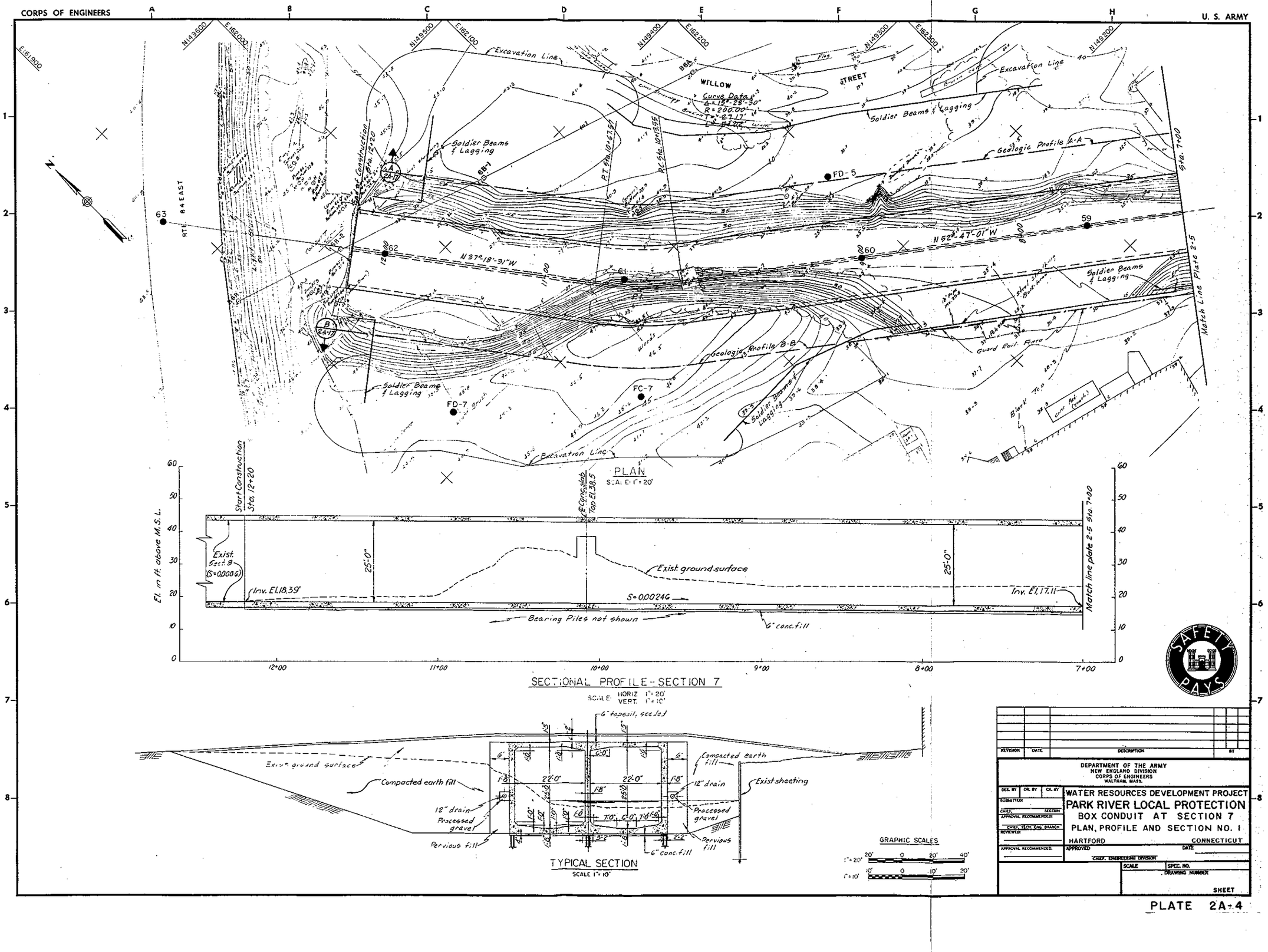
DES. BY	DR. BY J.A.P.	CK. BY
SUBMITTED:		
CHIEF, SECTION		
APPROVAL RECOMMENDED:		
CHIEF, TECH. ENG. BRANCH		
REVIEWED:		
PROJECT ENGINEER		
APPROVAL RECOMMENDED:		
CHIEF BRANCH		

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
BOX CONDUIT AT SECTION 9
PROFILES AND SECTIONS
HARTFORD CONNECTICUT
APPROVED DATE
CHIEF, ENGINEERING DIVISION
SCALE SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 2A-3

CORPS OF ENGINEERS

U. S. ARMY



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION

BOX CONDUIT AT SECTION 7

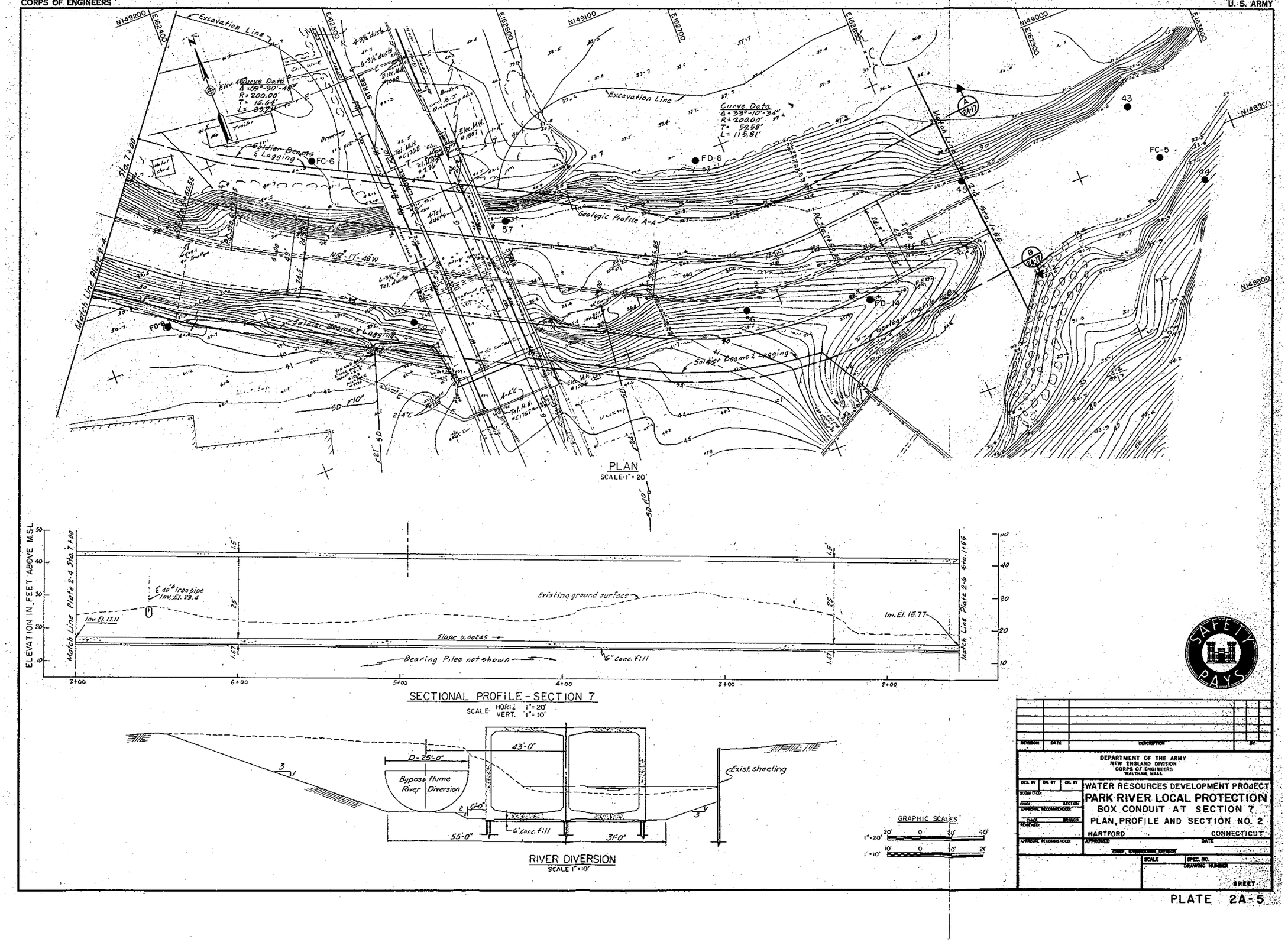
PLAN, PROFILE AND SECTION NO. 1

HARTFORD CONNECTICUT

PLATE 2A-4

CORPS OF ENGINEERS

U. S. ARMY



SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED
CHIEF, SECTION
APPROVAL RECOMMENDED
CHIEF, BRANCH
REVIEWED
APPROVAL RECOMMENDED

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION

BOX CONDUIT AT SECTION 7
PLAN, PROFILE AND SECTION NO. 2

HARTFORD CONNECTICUT

APPROVED DATE

CHIEF, ENGINEERING DIVISION

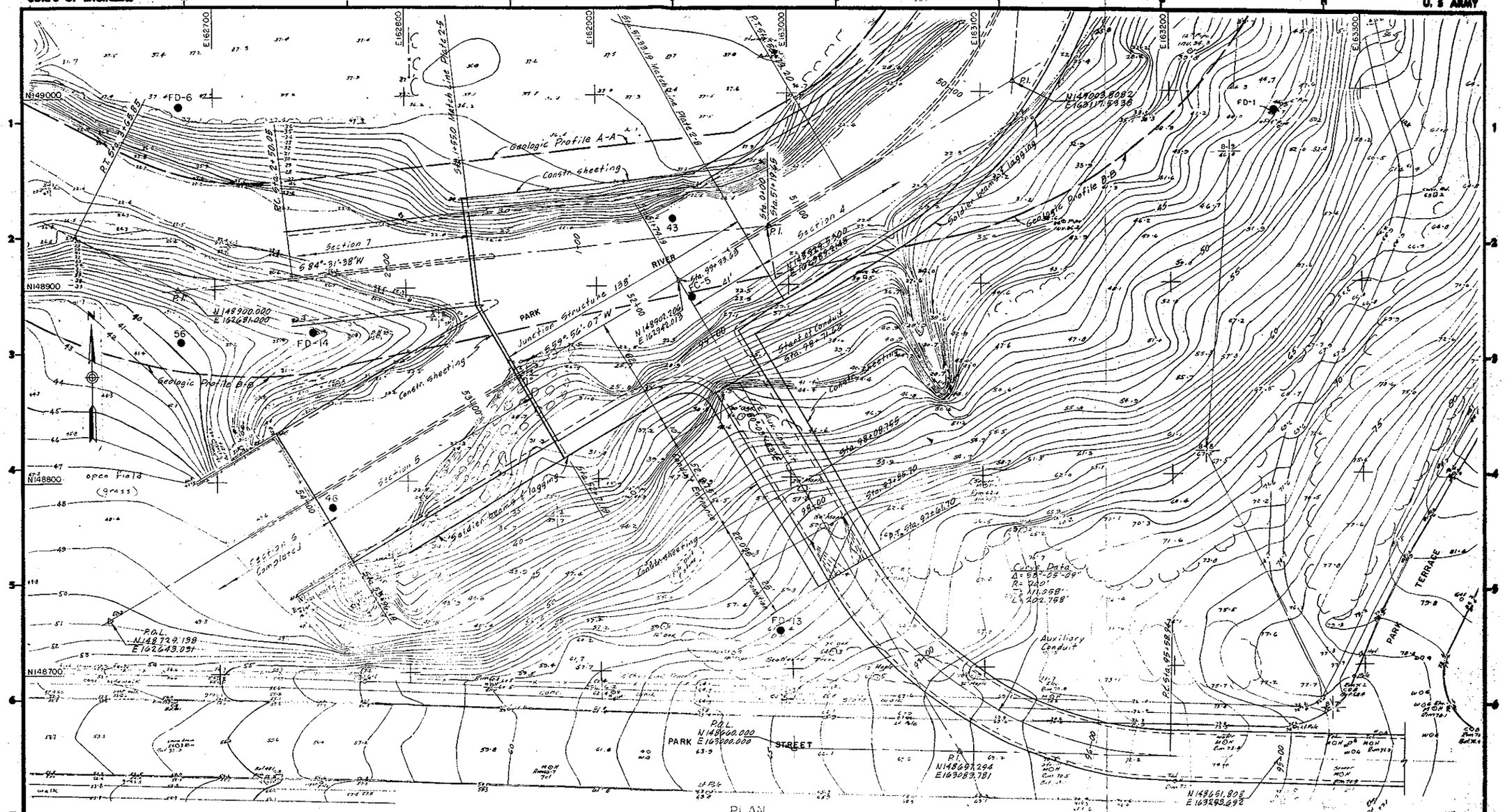
SCALE | SPEC. NO. | DRAWING NUMBER

SHEET

PLATE 2A-5

CORPS OF ENGINEERS

U. S ARMY



PLAN

SCALE 1"=20'

Notes:
1. For Geologic Profile A-A & B-B, see Plates 2A-17 and 2A-19

GRAPHIC SCALES

1"=20' 0 20' 40'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY	DR. BY	CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION
BOX CONDUIT AT SECTION 5 AND JUNCTION STRUCTURE
PLAN

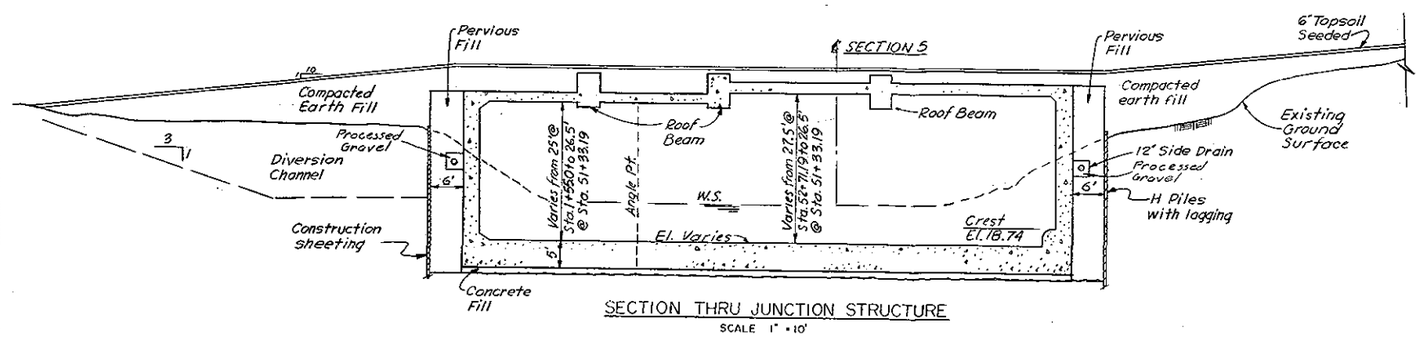
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE SPEC. NO.
DRAWING NUMBER
SHEET

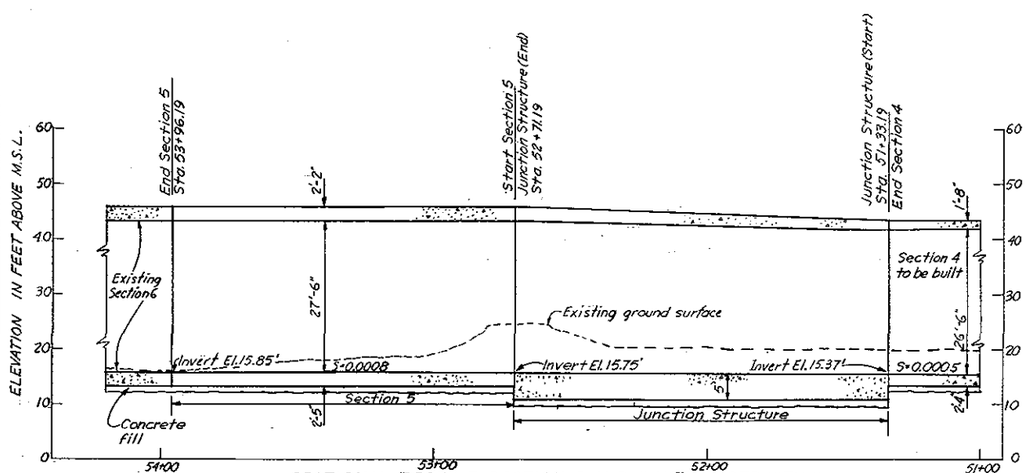
PLATE 2A-6

CORPS OF ENGINEERS — U. S. ARMY



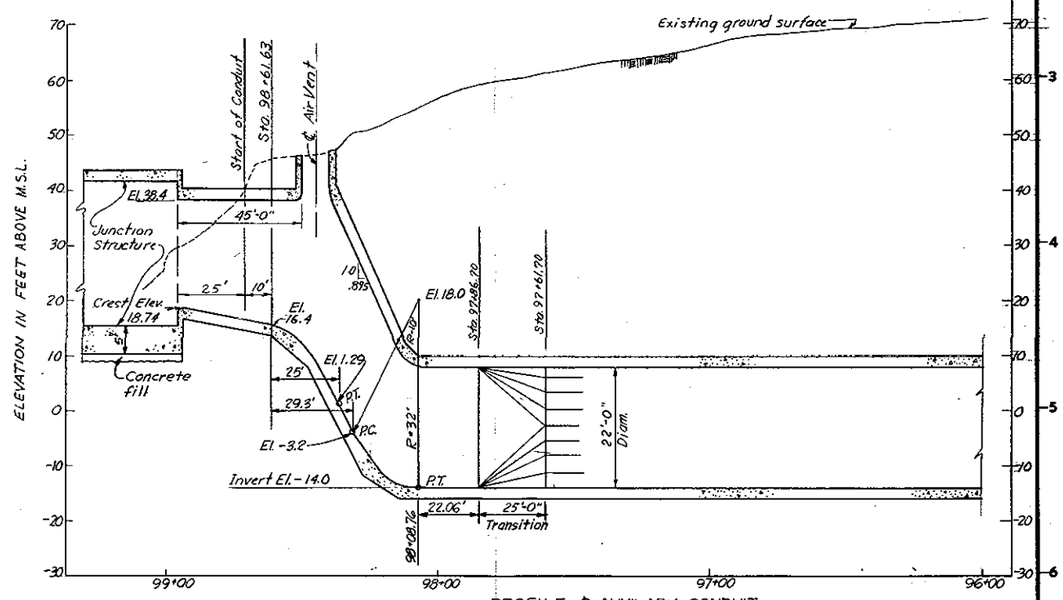
SECTION THRU JUNCTION STRUCTURE

SCALE 1" = 10'



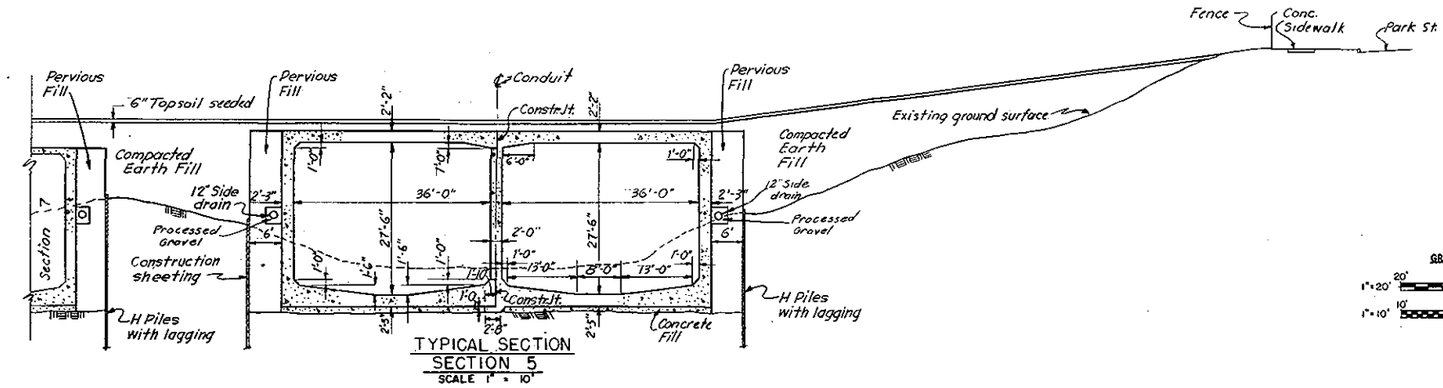
SECTIONAL PROFILE SECTION 5 AND JUNCTION STRUCTURE

SCALE: HORZ. 1" = 20' VERT. 1" = 10'



PROFILE ℄ AUXILARY CONDUIT

SCALE: HORZ. 1"=20' VERT. 1"=10'



TYPICAL SECTION SECTION 5

SCALE 1" = 10'

GRAPHIC SCALES

1"=20' 20' 0 20' 40'

1"=10' 10' 0 10' 20'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED: CHIEF, SECTION

APPROVAL RECOMMENDED: CHIEF, TECH. ENG. BRANCH

RECOMMEND: PROJECT ENGINEER

APPROVAL RECOMMENDED: CHIEF BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION

BOX CONDUIT AT SECTION 5 AND JUNCTION STRUCTURE PROFILE AND SECTIONS

HARTFORD CONNECTICUT

APPROVED: DATE:

CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.

DRAWING NUMBER

SHEET

PLATE 2A-7

CORPS OF ENGINEERS

U. S. ARMY

PLAN
SCALE: 1" = 20'

SECTIONAL PROFILE — SECTION 4
SCALE: HOR. 1" = 20'
VERT. 1" = 10'

TYPICAL SECTION
SCALE 1" = 10'

GRAPHIC SCALES

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
BOX CONDUIT AT SECTION 4
PLAN, PROFILE AND SECTION NO. 1
HARTFORD CONNECTICUT

APPROVED
CHIEF, ENGINEERING DIVISION
DATE

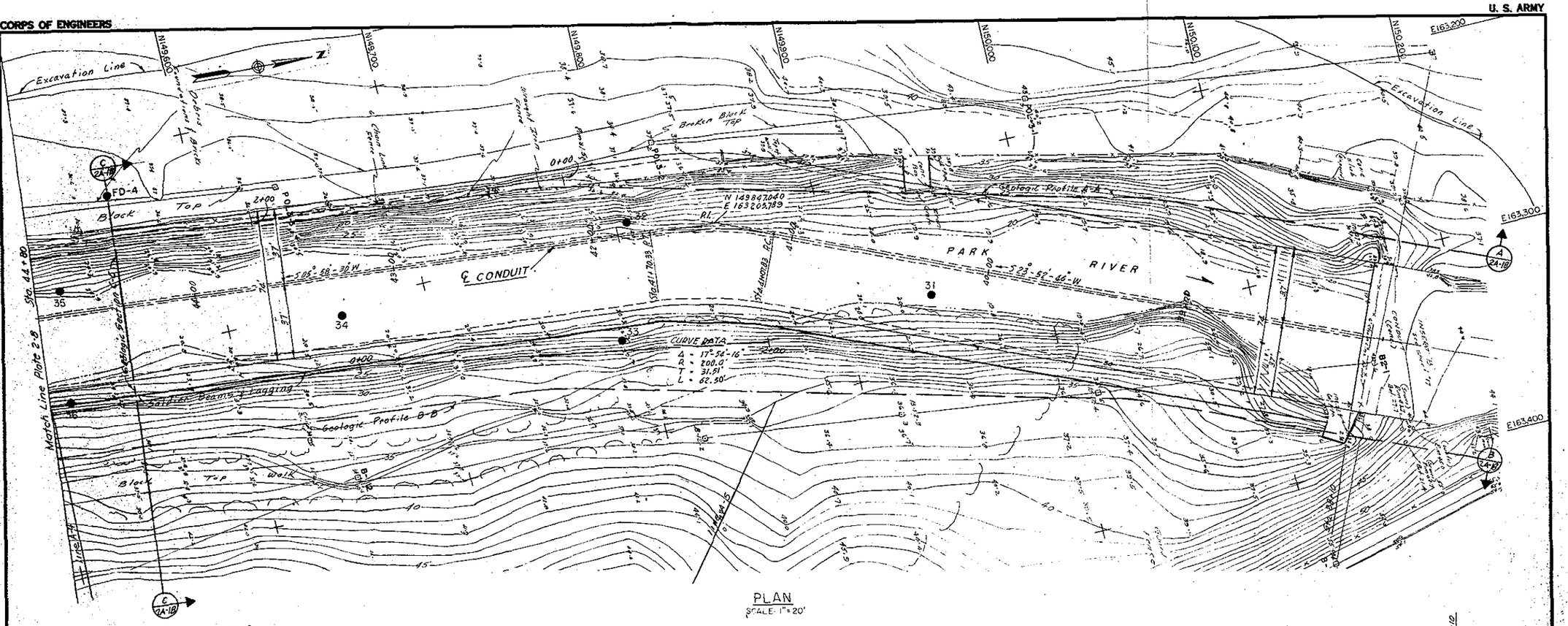
SCALE | SPEC. NO.
DRAWING NUMBER

SHEET

PLATE 2A-8

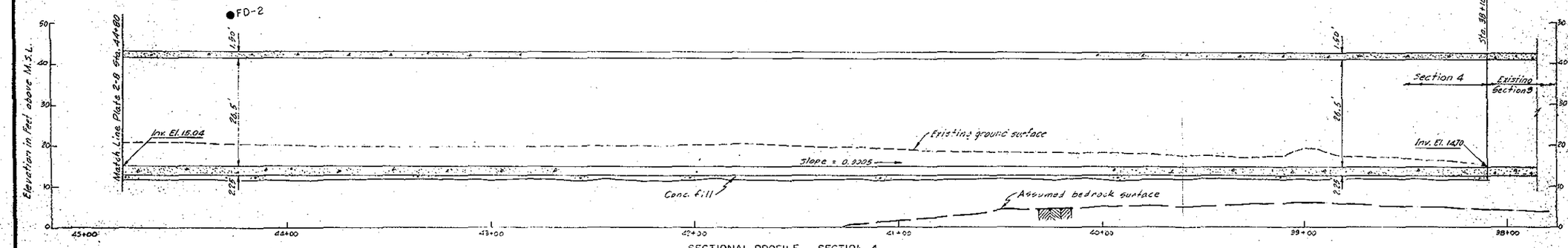
CORPS OF ENGINEERS

U. S. ARMY



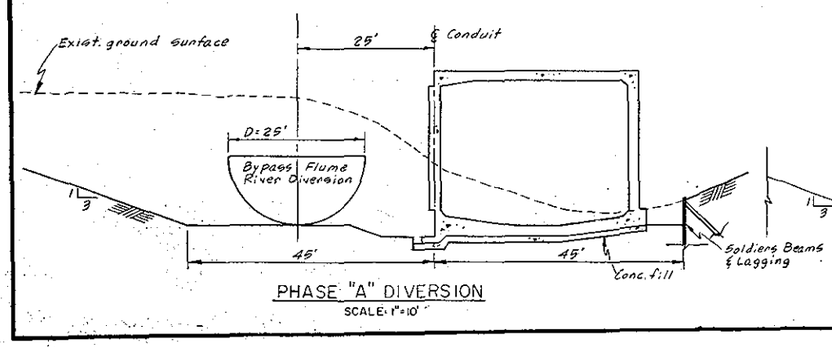
PLAN

SCALE: 1"=20'



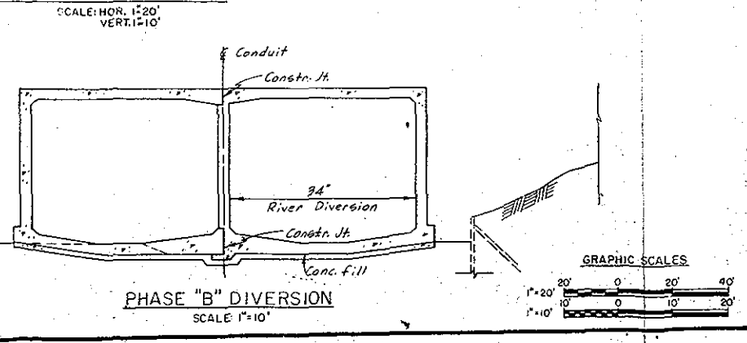
SECTIONAL PROFILE — SECTION 4

SCALE: HOR. 1"=20'
VERT. 1"=10'



PHASE "A" DIVERSION

SCALE: 1"=10'



PHASE "B" DIVERSION

SCALE 1"=10'

GRAPHIC SCALES

1"=20' 20' 0 20' 40'

1"=10' 10' 0 10' 20'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION

BOX CONDUIT AT SECTION 4
PLAN, PROFILE AND
SECTION NO. 2

HARTFORD CONNECTICUT

DES. BY | DR. BY | CK. BY

SUBMITTED: CHIEF, SECTION

APPROVAL RECOMMENDED: CHIEF, BRANCH

REVIEWED: PROJECT ENGINEER

APPROVAL RECOMMENDED: CHIEF, PROJECT BRANCH

APPROVED: CHIEF, ENGINEERING DIVISION DATE

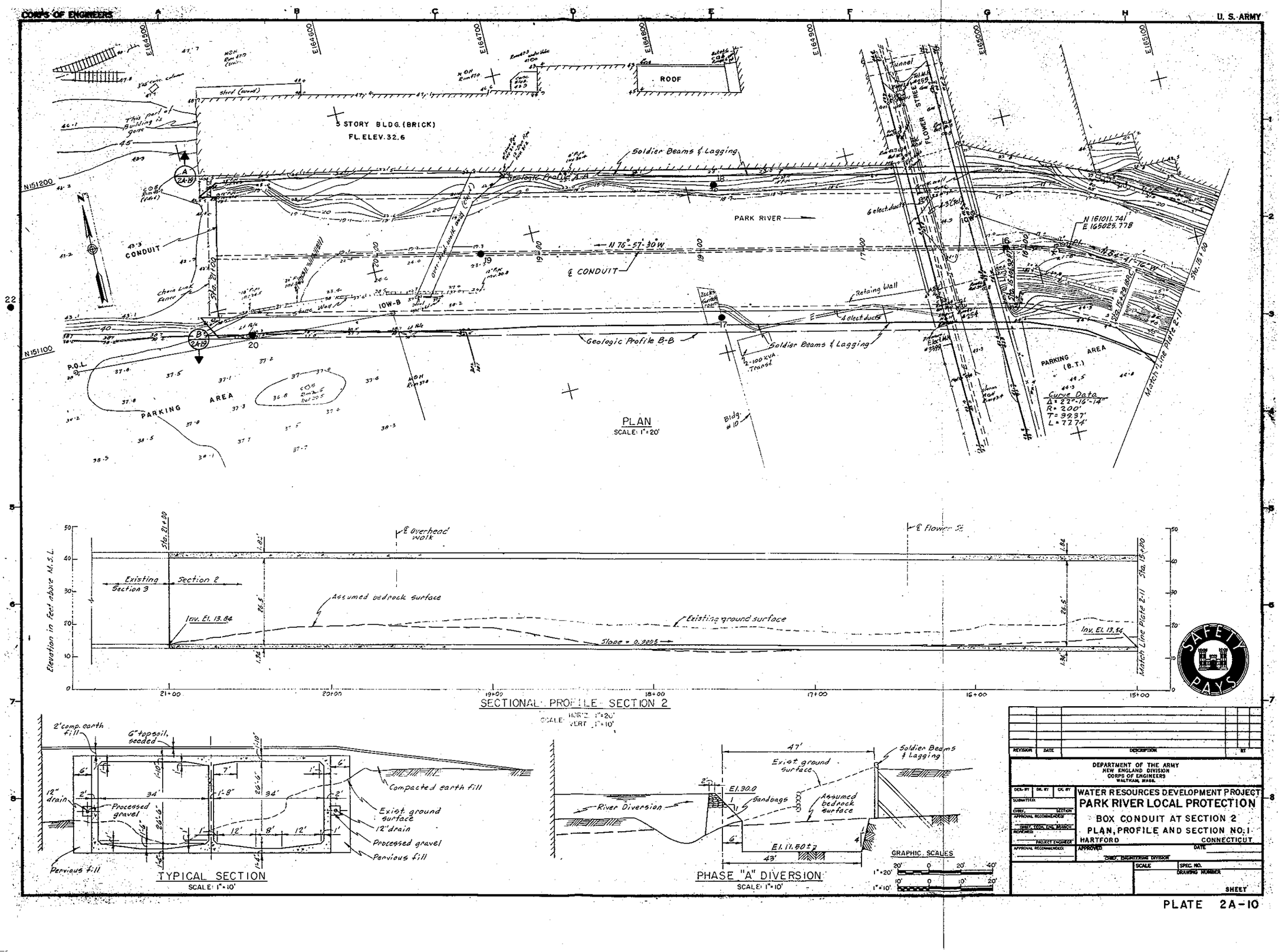
SCALE SPEC. NO.

DRAWING NUMBER

SHEET

PLATE 2A-9

CORPS OF ENGINEERS — U. S. ARMY



SECTIONAL PROFILE - SECTION 2

SCALE: HORIZ. 1"=20'
VERT. 1"=10'

TYPICAL SECTION

SCALE: 1"=10'

PHASE "A" DIVERSION

SCALE: 1"=10'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY	DET. BY	CK. BY
SUBMITTED:		
CHIEF, SECTION:		
APPROVAL RECOMMENDED:		
CHIEF, ENGR. DATA BRANCH:		
REVIEWED:		
PROJECT ENGINEER:		
APPROVAL RECOMMENDED:		

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
BOX CONDUIT AT SECTION 2
PLAN, PROFILE AND SECTION NO. 1
HARTFORD CONNECTICUT

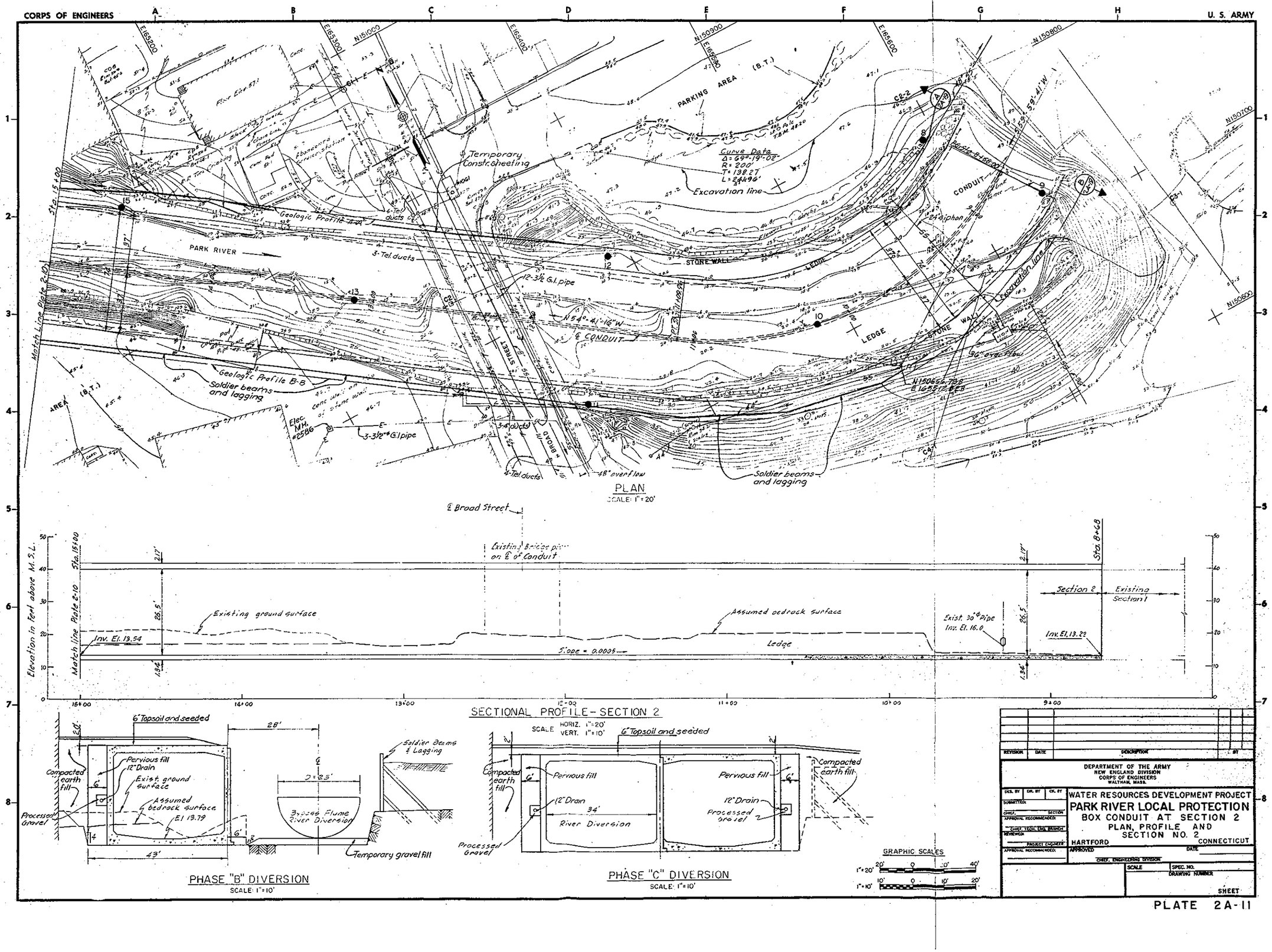
APPROVED: _____ DATE: _____
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO. | DRAWING NUMBER | SHEET

SAFETY PAYS

PLATE 2A-10

CORPS OF ENGINEERS — U. S. ARMY



REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION

BOX CONDUIT AT SECTION 2

PLAN, PROFILE AND SECTION NO. 2

HARTFORD — CONNECTICUT

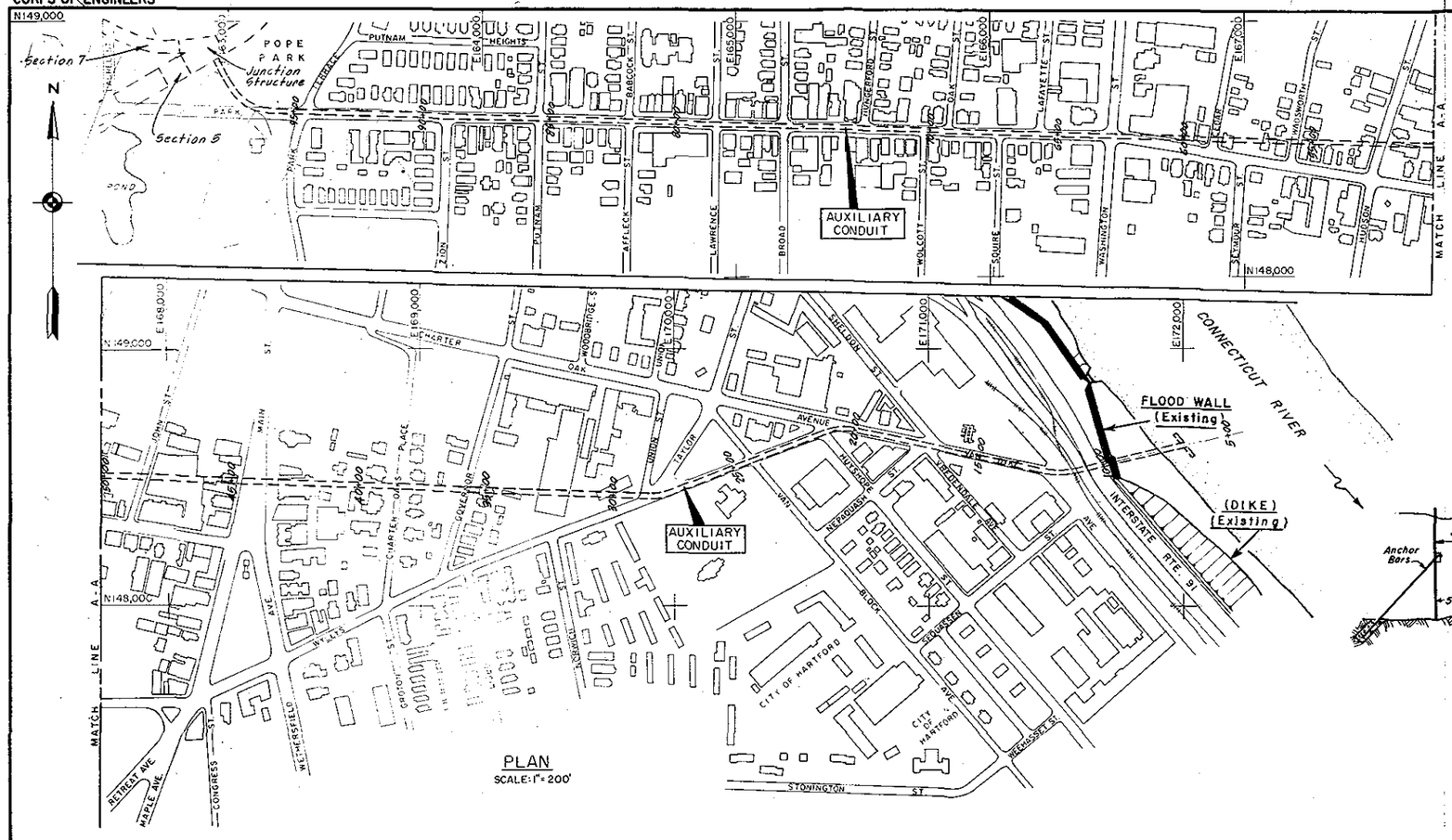
APPROVED — DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 2A-11

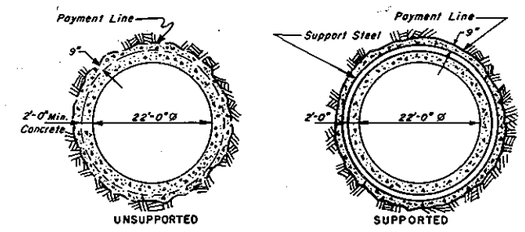
CORPS OF ENGINEERS

U. S. ARMY

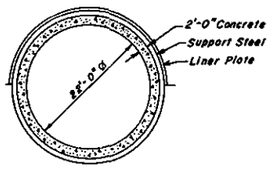


PLAN

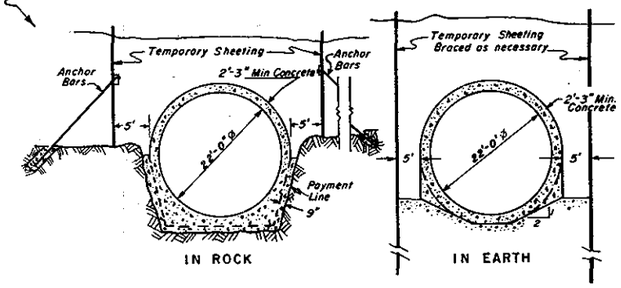
SCALE: 1" = 200'



TUNNEL IN ROCK



TUNNEL IN EARTH

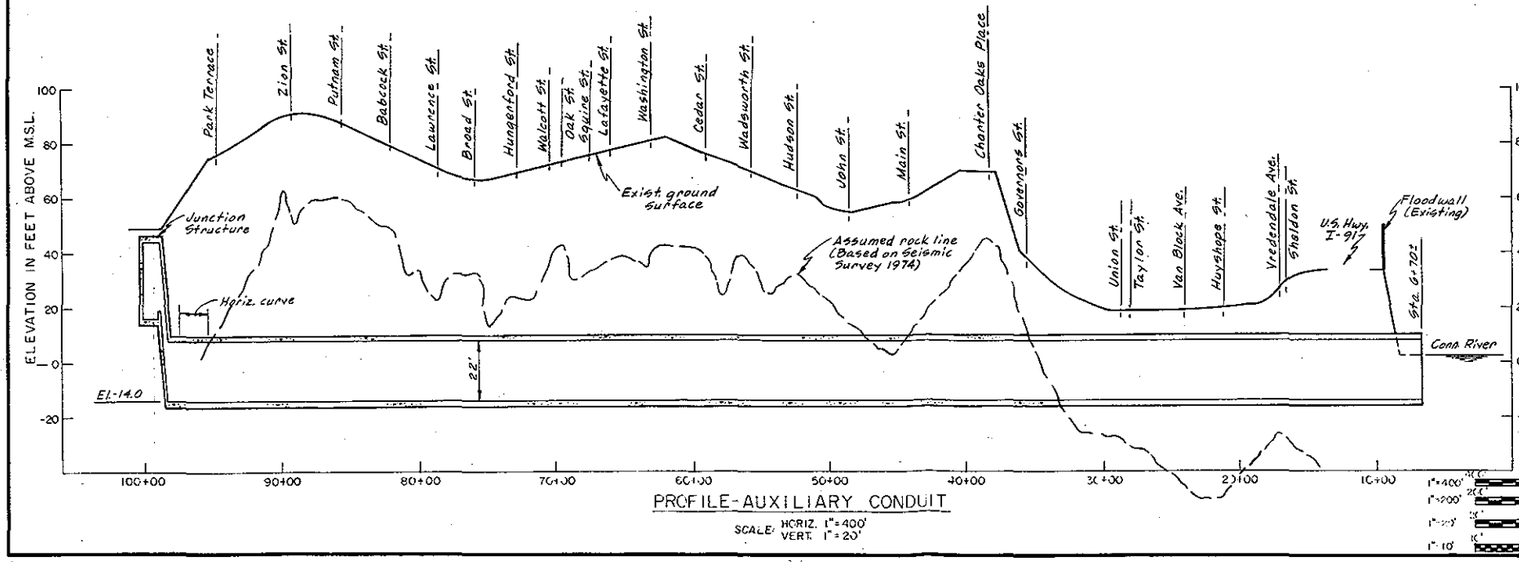


CUT & COVER CONDUIT

AUXILIARY CONDUIT

TYPICAL SECTIONS

SCALE 1" = 10'-0"



PROFILE-AUXILIARY CONDUIT

SCALE: HORIZ. 1" = 400'
VERT. 1" = 20'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY	DR. BY	CK. BY
SUBMITTED		
CHIEF, SECTION		
APPROVED, RECOMMENDED		
CHIEF, TECH. ENG. BRANCH		
REVIEWED		
PROJECT ENGINEER		
APPROVAL RECOMMENDED		
CHIEF, BRANCH		

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION

AUXILIARY CONDUIT TUNNEL
PLAN, PROFILE, AND SECTIONS

HARTFORD CONNECTICUT

APPROVED DATE

CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.

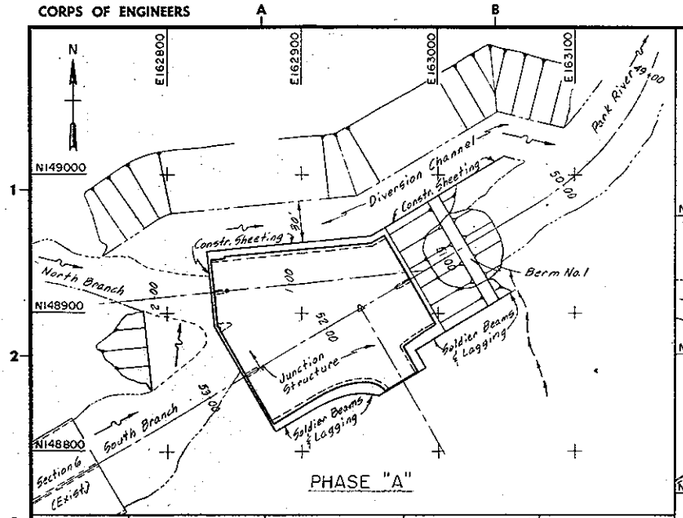
DRAWING NUMBER

SHEET

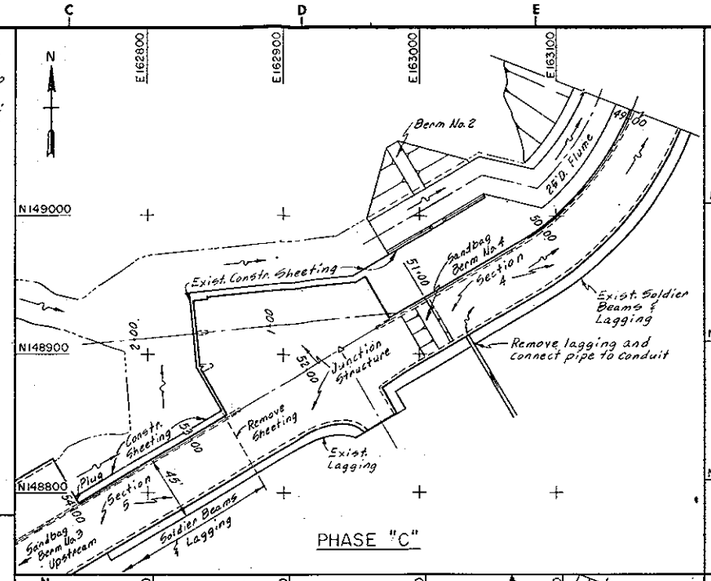
PLATE 2A-12

CORPS OF ENGINEERS

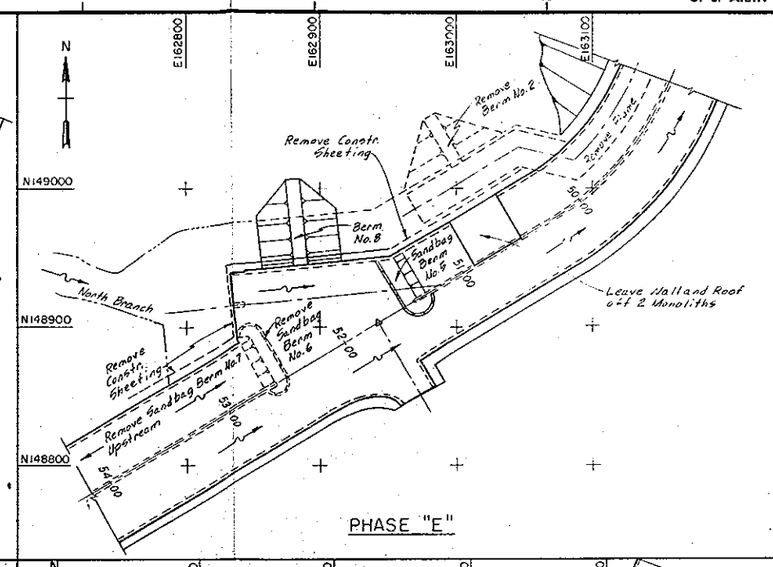
U. S. ARMY



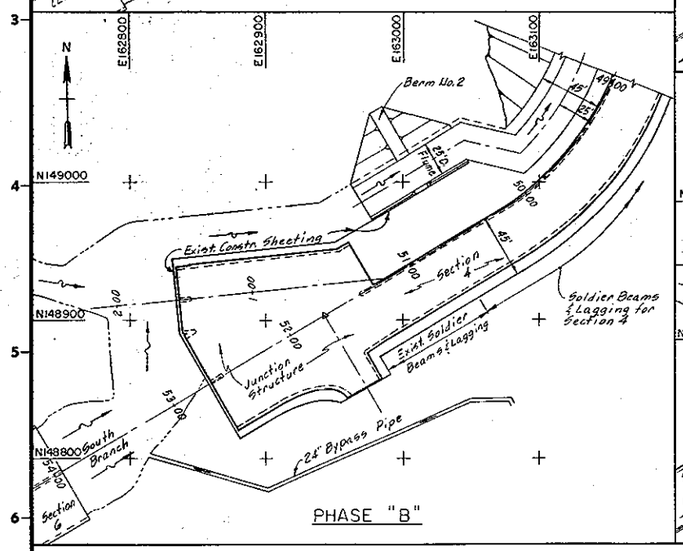
PHASE "A"



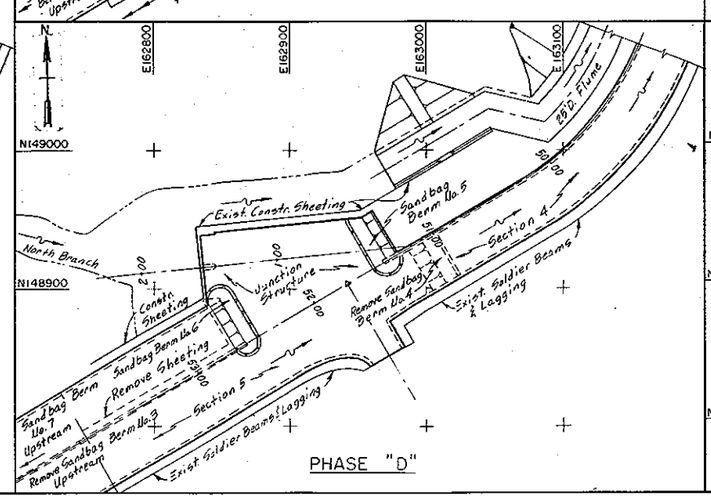
PHASE "C"



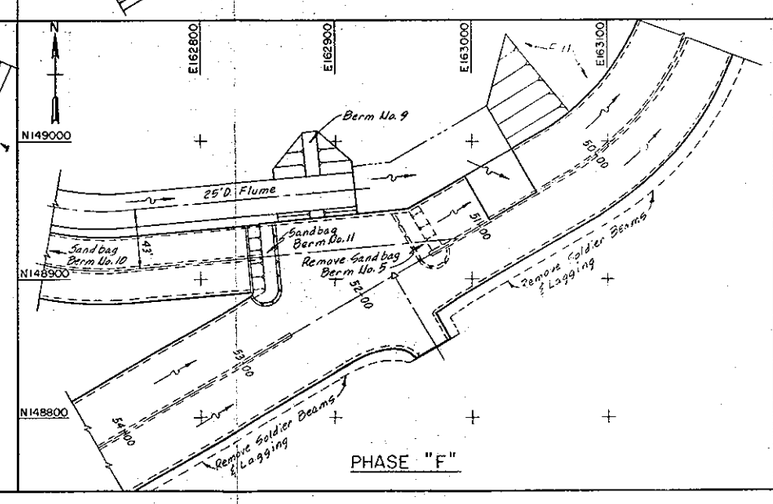
PHASE "E"



PHASE "B"



PHASE "D"



PHASE "F"

PHASE "A"

1. Excavate diversion channel.
2. Drive sheeting, soldier beams and place lagging.
3. Construct berm no.1.
4. Excavate for and construct junction structure.

PHASE "B"

1. Excavate for and install flume for section 4.
2. Construct berm no.2 to divert river thru the flume.
3. Use 24" bypass pipe to divert stream from pope hill to south branch.
4. Remove berm no.1.
5. Excavate for and construct right barrel of section 4.

PHASE "C"

1. Construct sandbag berms no.3 and no.4.
2. Connect stream from pope park to right barrel of section 4.
3. Drive soldier beams and place lagging south side of section 5 and drive sheet piling to the left of the centerline of section 5.
4. Remove sheet piling at right barrel of section 5.
5. Excavate for and install right barrel of section 5.

PHASE "D"

1. Remove sandbag berm no.4 and construct sandbag berm no.5.
2. Remove sandbag berm no.3 and construct sandbag berm no.6.
3. Construct sandbag berm no.7 to complete diversion of south branch thru right barrel of section 5, junction structure and right barrel of section 4.
4. Place construction sheeting along north side and remove sheeting to the left of the centerline and at the end of section 5 as shown.
5. Excavate for and construct left barrel of section 5.

PHASE "E"

1. Remove sandbag berms no.6 and no.7.
2. Remove construction sheeting along north side of section 5, west end of junction structure and north side of section 4.
3. Remove berm no.2, flume for section 4 and place berm no.8 to complete diversion of water thru section 5, junction structure and right barrel of section 4.
4. Excavate for and construct left barrel of section 4 except for outside wall and roof of two monoliths as shown.

PHASE "F"

1. Backfill north side of section 4 as shown.
2. Remove berm no.8, install flume for section 7, berm no.9, sandbag berm no.10, north end of section 8 and sandbag berm no.11, to complete diversion of the north branch thru the flume and into the left barrel of section 4.
3. Excavate for and construct section 7.
4. Remove sandbag berms no.10 and no.11.
5. Remove berm no.9, flume for section 7 and backfill section 7.
6. Complete the walls and roof of the two monoliths of the north barrel of section 4.
7. Remove sandbag berm no.5.
8. Remove all construction sheeting, soldier beams and lagging.
9. Backfill all sections and junction structure.

SAFETY PAYS

GRAPHIC SCALES

1" = 40' 40' 0 40' 80'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. EXPL. BRANCH
RESOURCES
PROJECT ENGINEER

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION CONTROL AND DIVERSION OF WATER JUNCTION STRUCTURE PLANS

HARTFORD CONNECTICUT

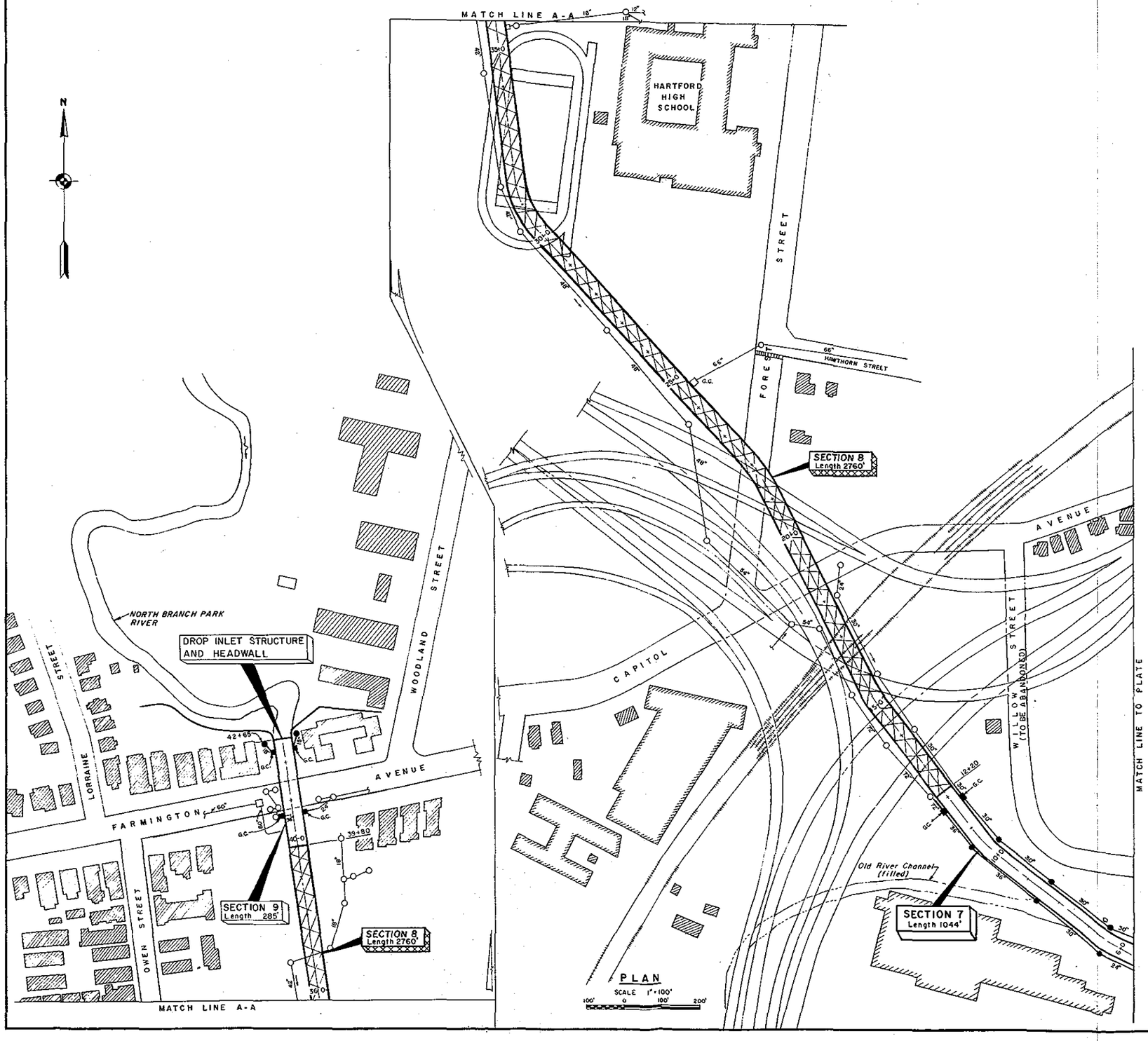
APPROVAL RECOMMENDED:
CHIEF, ENGINEERING DIVISION
APPROVED
DATE
CHIEF BRANCH

SCALE
SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 2A-13

CORPS OF ENGINEERS

U. S. ARMY



N

LEGEND

- N.P.C. — New Pressure Conduit
- New Street Inlet
- Existing Drain Inlet
- New Drain Inlet
- G.C. — New Gate Chamber
- 15" — Existing Storm Drain
- 30" — New Storm Drain
- G.C. — Existing Gate Chamber

Corps of Engineers Modified Plan

Completed Work by Connecticut Highway Department and City of Hartford.

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
WALTHAM, MASS.

DR. BY | TR. BY | CK. BY

PROJECT ENGINEER

SUBMITTED BY

CHIEF, PLANN. & R. E. BRANCH

APPROVED

CHIEF, ENGINEERING DIVISION

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
INTERIOR DRAINAGE
PLAN NO. 1

HARTFORD CONNECTICUT

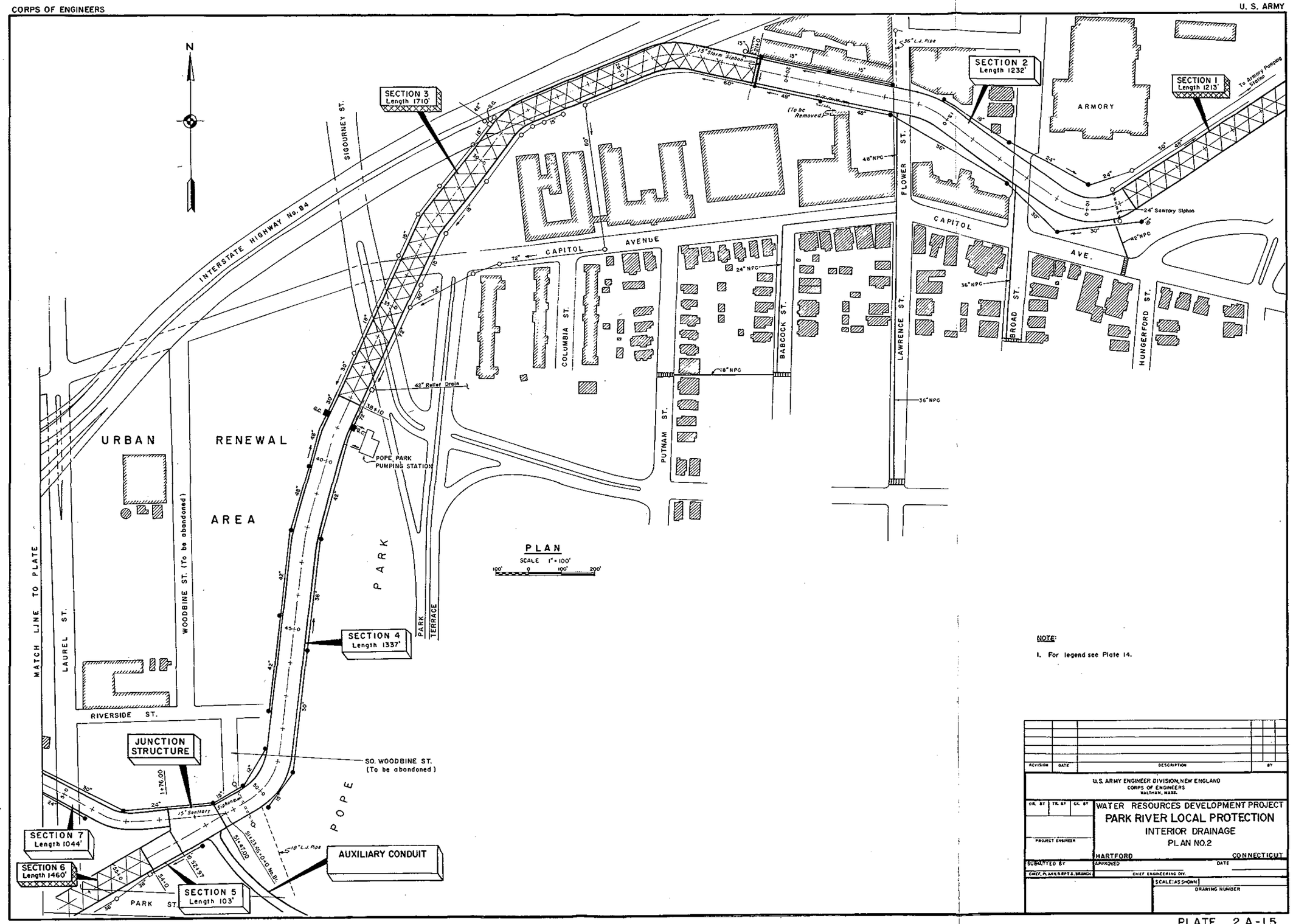
SCALE: AS SHOWN

DRAWING NUMBER

PLATE 2A - 14

CORPS OF ENGINEERS

U. S. ARMY



PLAN

SCALE 1" = 100'

100' 0 100' 200'

NOTE:

1. For legend see Plate 14.

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY

PROJECT ENGINEER

SUBMITTED BY

CHIEF, PLANS & RPTS. BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION

INTERIOR DRAINAGE

PLAN NO. 2

HARTFORD CONNECTICUT

APPROVED DATE

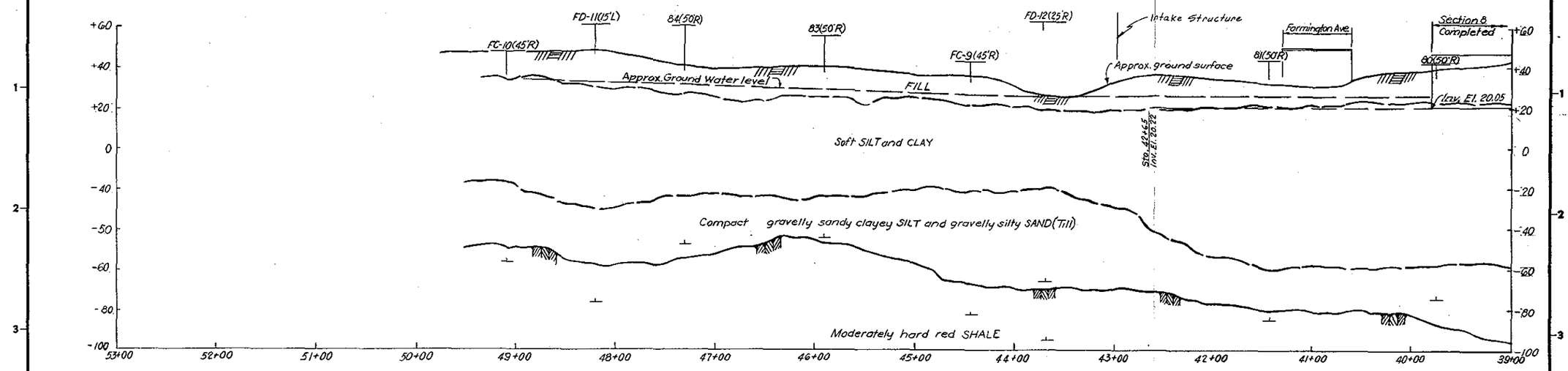
CHIEF ENGINEERING DIV.

SCALE: AS SHOWN

DRAWING NUMBER

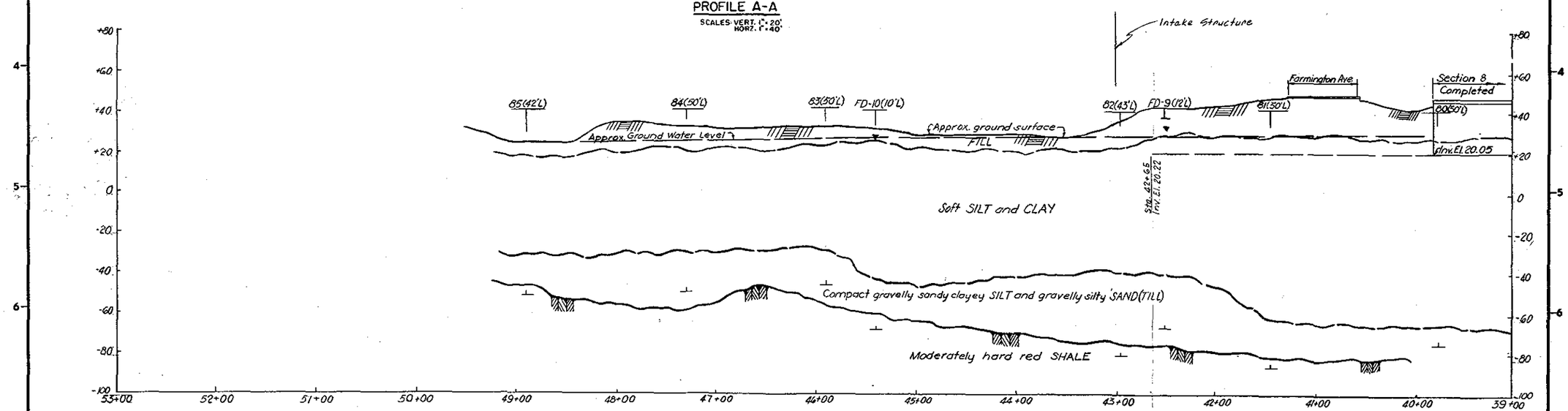
PLATE 2A-15

CORPS OF ENGINEERS A B C D E F G H U. S. ARMY



PROFILE A-A

SCALES: VERT. 1" = 20'
HORZ. 1" = 40'



PROFILE B-B

SCALES: VERT. 1" = 20'
HORZ. 1" = 40'

Notes:
For Plan of Explorations and location of Geologic Sections See Plate 2A-2.
For Typical Foundation Explorations see Appendix B.

SAFETY PAYS

GRAPHIC SCALES

1" = 40' 40' 0 20' 80'

1" = 20' 20' 0 20' 40'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF, BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION
BOX CONDUIT AT SECTION 9
GEOLOGIC PROFILES A-A AND B-B

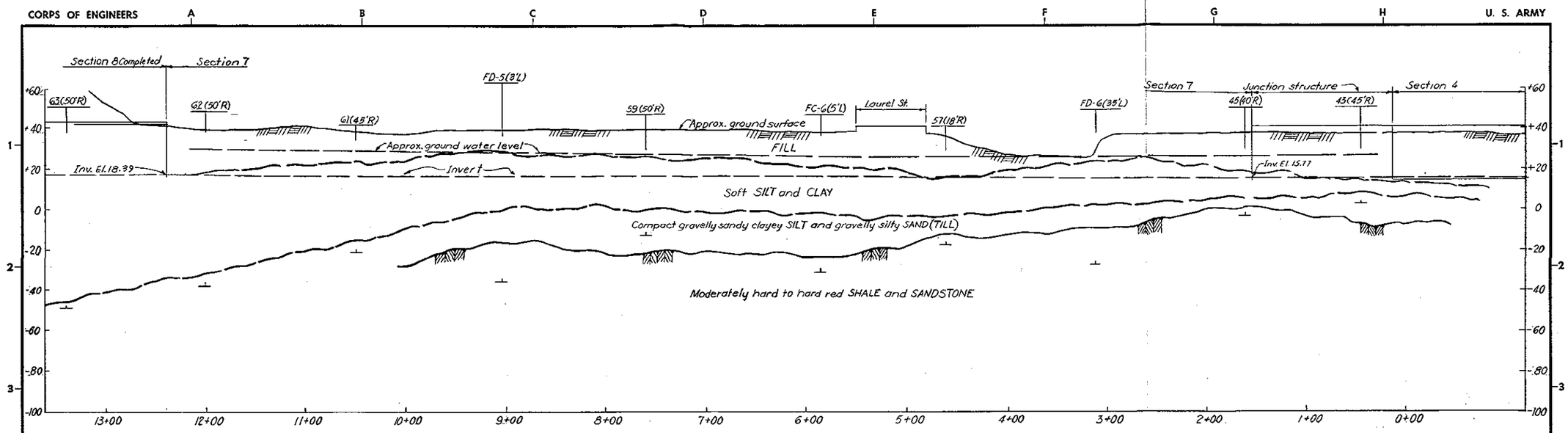
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

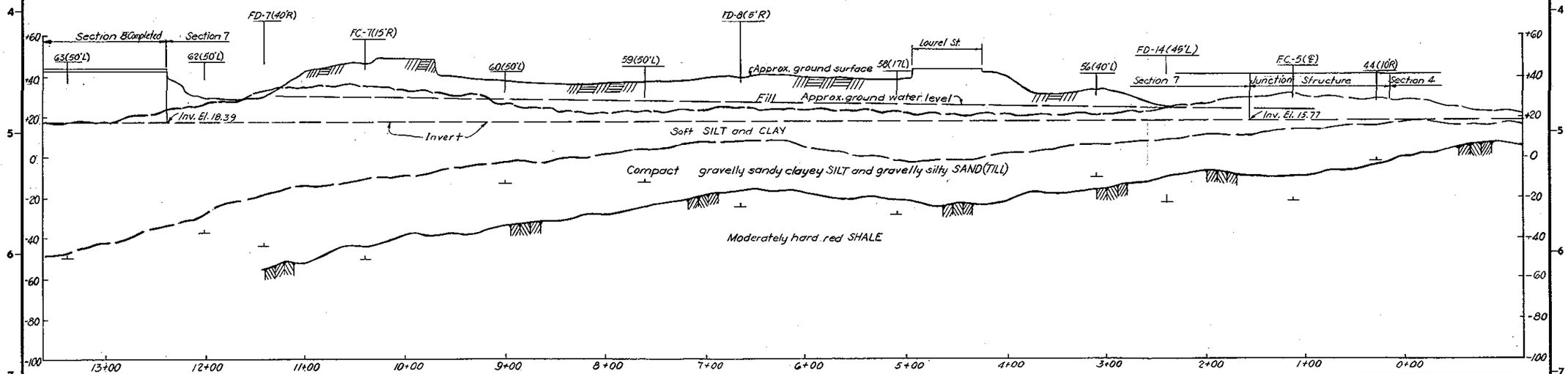
PLATE 2A-16

CORPS OF ENGINEERS — U. S. ARMY



PROFILE A-A

SCALES: VERT. 1"=20'
HORZ. 1"=40'



PROFILE B-B

SCALES: VERT. 1"=20'
HORZ. 1"=40'

Notes:
For Plan of Explorations and location of Geologic Sections see Plates 2A-4 & 2A-5.
For Typical Foundation Explorations see Appendix B.

GRAPHIC SCALES

1" = 20' 20' 0 20' 40'

1" = 40' 40' 0 40' 80'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF, BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION
BOX CONDUIT AT SECTION 7
GEOLOGIC PROFILES A-A AND B-B

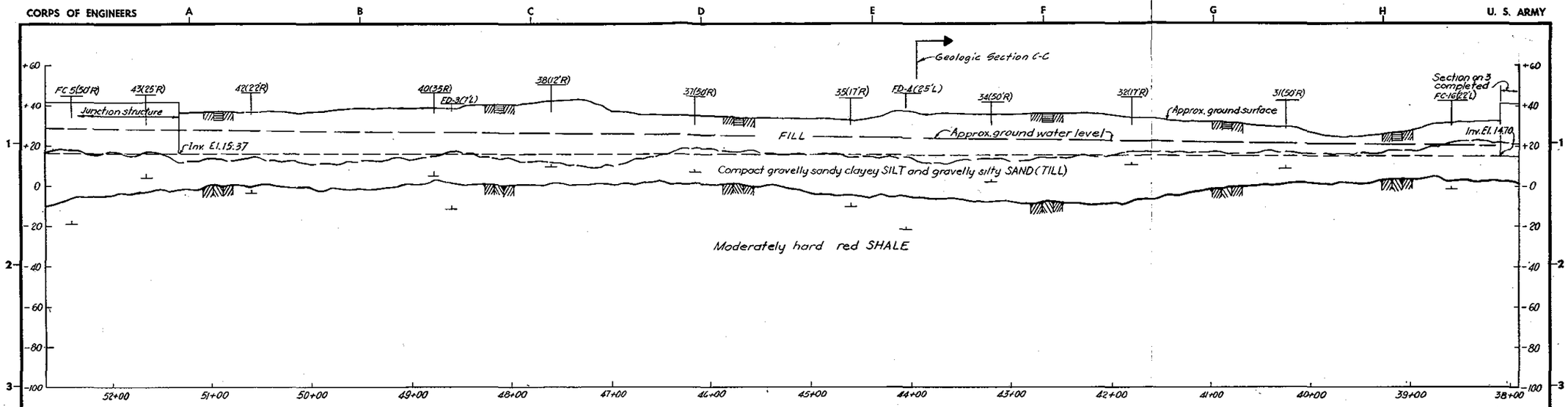
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

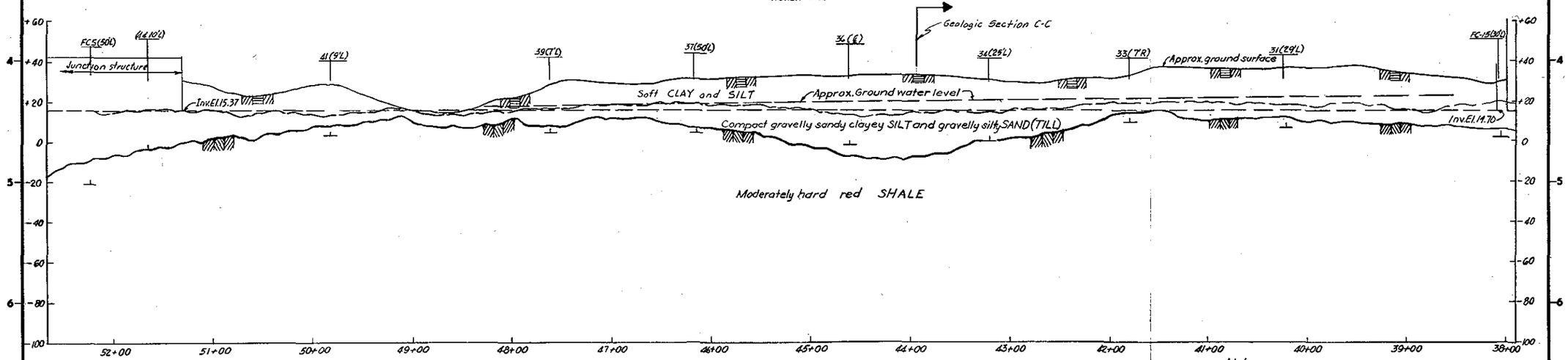
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 2A-17

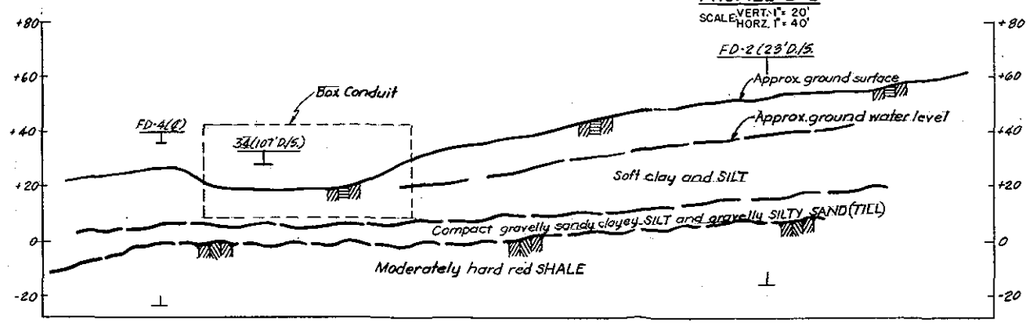
CORPS OF ENGINEERS — A B C D E F G H — U. S. ARMY



PROFILE A-A
SCALE: VERT. 1" = 20'
HORZ. 1" = 40'



PROFILE B-B
SCALE: VERT. 1" = 20'
HORZ. 1" = 40'



SECTION C-C (LOOKING DOWNSTREAM
SCALE: 1" = 20'

Notes:
For Plan of Explorations and location of Geologic Sections see Plates 2A-8 & 2A-9.
For Typical Foundation Explorations see Appendix B.

SAFETY PAYS

GRAPHIC SCALES
1" = 20' 20' 0 20' 40'
1" = 40' 40' 0 40' 80'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY
SUBMITTED
CHIEF, SECTION
APPROVAL RECOMMENDED
CHIEF, TECH. ENG. BRANCH
REVIEWED
PROJECT ENGINEER
APPROVAL RECOMMENDED
CHIEF BRANCH

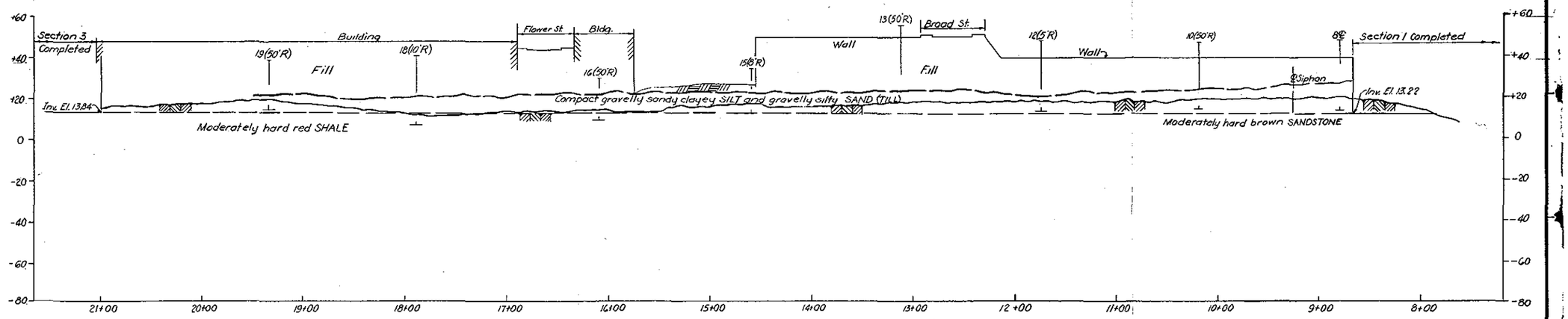
WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
BOX CONDUIT AT SECTION 4
GEOLOGIC PROFILES A-A, B-B AND SECTION D-D
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

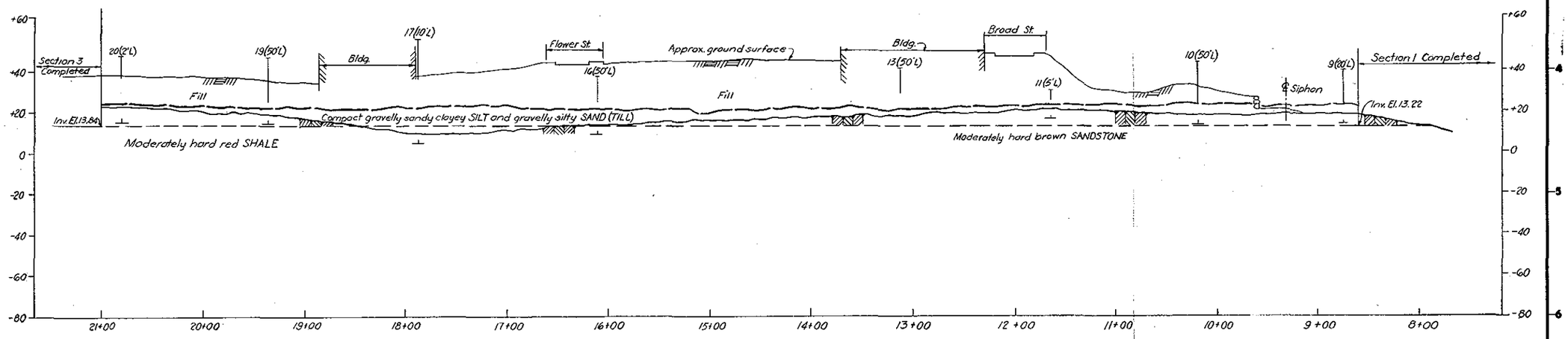
PLATE 2A-18

CORPS OF ENGINEERS A B C D E F G H U. S. ARMY



PROFILE A-A

SCALE: VERT. 1" = 20'
HORZ. 1" = 40'



PROFILE B-B

SCALE: VERT. 1" = 20'
HORZ 1" = 40'

Notes:

For Plan of Explorations and locations of Geologic Sections see Plates 2A-10 & 2A-11.

For Typical Foundation Explorations see Appendix B.

GRAPHIC SCALES

1" = 20' 20' 0 20' 40'

1" = 40' 40' 0 40' 80'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:

CHIEF, SECTION
APPROVAL RECOMMENDED:

CHIEF, TECH. ENG. BRANCH
REVIEWED:

PROJECT ENGINEER
APPROVAL RECOMMENDED:

CHIEF BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION

BOX CONDUIT AT SECTION 2

GEOLOGIC PROFILES A-A & B-B

HARTFORD CONNECTICUT

APPROVED DATE

CHIEF, ENGINEERING DIVISION

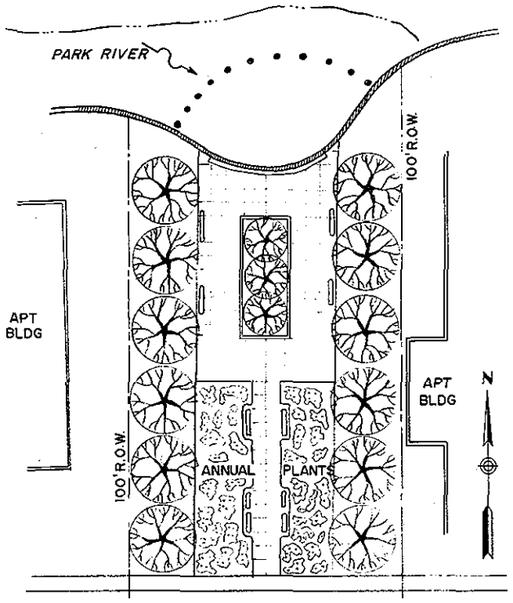
SCALE | SPEC. NO.

DRAWING NUMBER

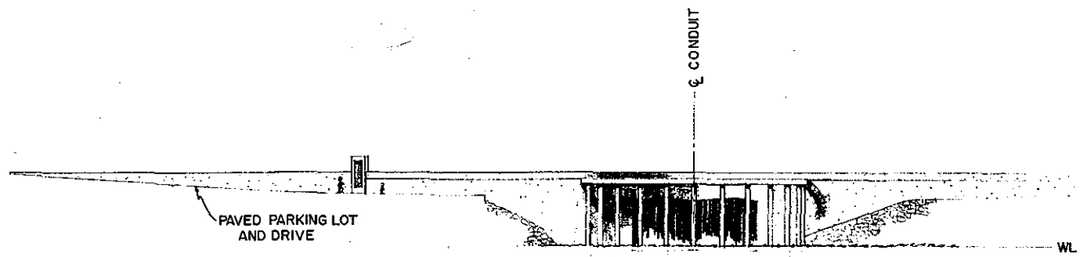
SHEET

PLATE 2A-19

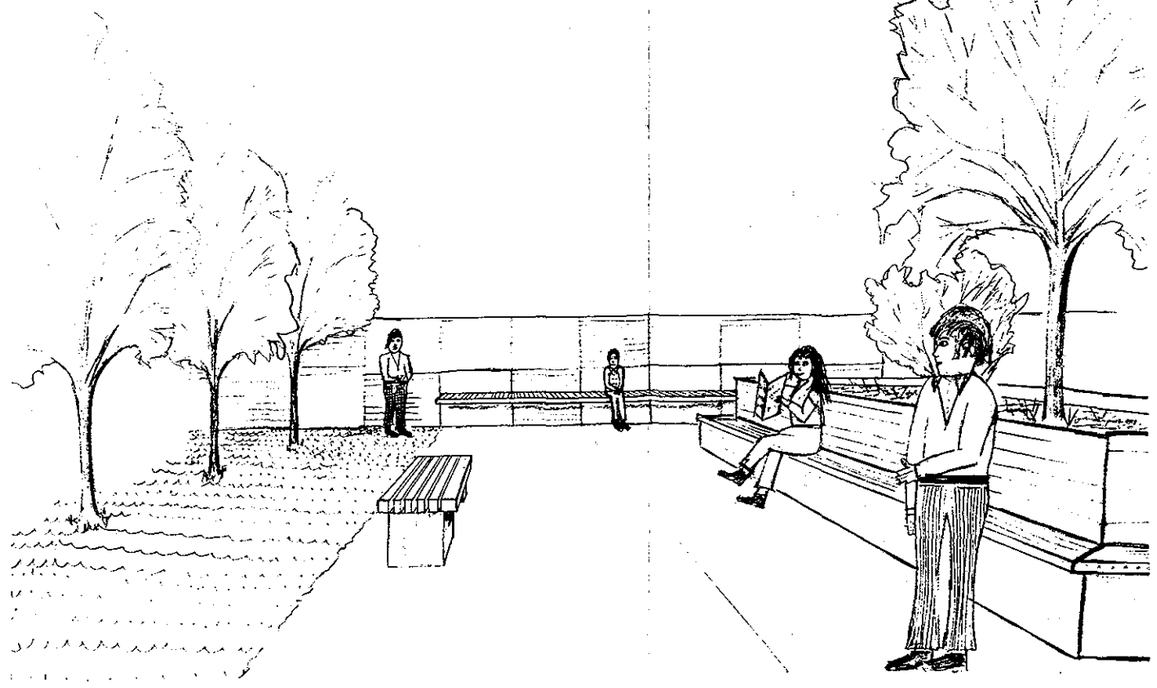
CORPS OF ENGINEERS — A B C D E F G H — U. S ARMY



FARMINGTON AVE. SITTING AREA
SCALE: 1"=20'-0"



INLET STRUCTURE ELEVATION
SCALE: 1"=20'-0"



PERSPECTIVE VIEW OF SITTING AREA

GRAPHIC SCALES
1"=40' 40' 0 40' 80'
1"=20' 20' 0 20' 40'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

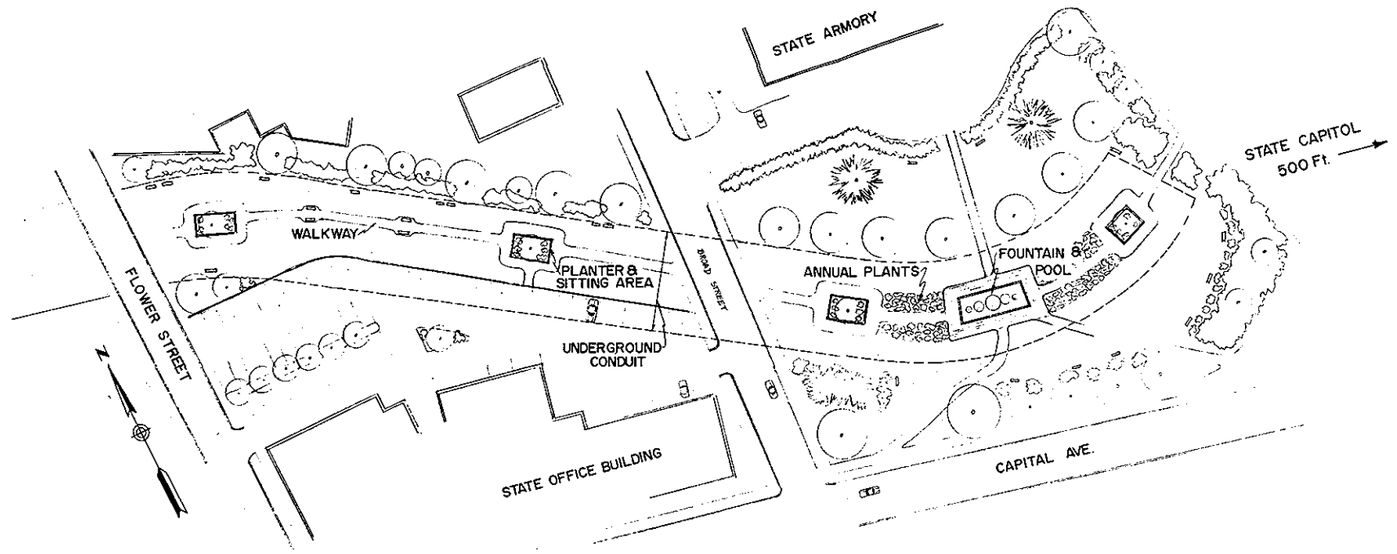
DES. BY | DR. BY | CK. BY
SUBMITTED
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
RECOMMEND:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF, BRANCH

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
ENVIRONMENTAL ENHANCEMENT
FARMINGTON AVE.
PLAN, ELEVATION AND PERSPECTIVE
HARTFORD CONNECTICUT
APPROVED DATE:
CHIEF, ENGINEERING DIVISION

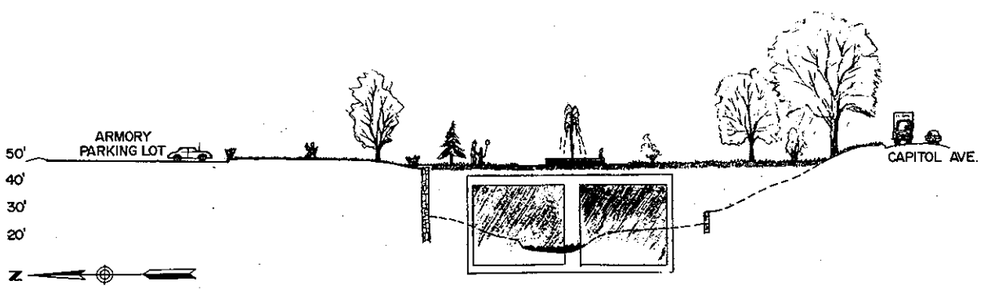
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 2A-20

CORPS OF ENGINEERS — A B C D E F G H — U. S ARMY



BUSHNELL PARK WEST
SCALE: 1" = 40'-0"



SECTION SOUTH OF THE ARMORY
SCALE: 1" = 20'-0"

GRAPHIC SCALES
1" = 40' 40' 0 40' 80'
1" = 20' 20' 0 20' 40'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
ENVIRONMENTAL ENHANCEMENT
BUSHNELL PARK WEST
PLAN AND SECTION
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 2A-21

APPENDIX A

DOCUMENTS OF COMMENT AND CONCURRENCE
PARK RIVER LOCAL PROTECTION
HARTFORD, CONNECTICUT

CONTENTS

CITY OF HARTFORD

COURT OF COMMON COUNCIL

550 MAIN STREET

HARTFORD, CONNECTICUT

Clerk
Robert J. Gallivan

Councilmen

Richard M. Brown
Nicholas R. Carbone
John J. Cunnane, Jr.
William A. Di Bella
Mary M. Heslin
George Levine
Allyn A. Martin
Richard Suisman
Margaret V. Tedone

February 4, 1974

This is to certify that at a meeting of the Court of Common Council, January 14, 1974, the following RESOLUTION was passed.

WHEREAS, The well-being of the City of Hartford is very dependent on flood protection;and

WHEREAS, The City of Hartford is protected at present by approximately seven miles of dikes and flood walls, a Park River Conduit and four pumping stations; and

WHEREAS, These local flood control works are supplemented by approximately sixteen dams further north in the Connecticut River basin constructed by the Corps of Engineers; and

WHEREAS, The City of Hartford has been a leader in flood protection for the area even prior to the very tragic floods of 1936; and

WHEREAS, The City of Hartford has expended considerable funds for the construction and maintenance of its flood protection works; now, therefore, be it

RESOLVED, That the Council of the City of Hartford officially informs herein the New England River Basins Commission of its support in principle for the continued maintenance and improvements of flood control works providing that the local Council be given the right of review so that various avenues of flood control such as flood plain zoning may be explored most especially in proximity to the City of Hartford and also throughout the Connecticut River Basin to assure maximum protection to the City at all times; and be it further

RESOLVED, That the City will work closely with the Corps of Engineers' proposed flood control plan as recommended in the "Comprehensive Water and Related Resources Investigation, Connecticut River Basin" that concerns several dams in the Connecticut River Basin important to the safety of Hartford and especially important to the City flood control work on the Park River.

Attest:

Robert J. Gallivan,
City Clerk.

EXHIBIT 1

Asylum Hill Inc.
217 Farmington Avenue Hartford, Connecticut 06105 522-4241

Robert F. Robotham
Executive Director

June 13, 1974

Colonel John H. Mason
Division Engineer
Department of the Army
New England Division,
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Mason:

I've recently reviewed the proposed Park River Flood Control Project with the City of Hartford Engineering Department. I was particularly interested in that portion of the project north of Farmington Avenue and discussed pending programs for this section of the river.

I believe current plans call for construction of a head wall and retaining dikes approximately one hundred feet north of Farmington Ave. This barrier is designed to eliminate the constriction caused by the present bridge at Farmington Avenue and to prevent deterioration of the piles upon which the bridge is constructed.

We endorse this concept and believe that it will produce better traffic circulation upon Farmington Avenue while permitting development of the upper Park River as a linear park and green area.

If we may be of assistance, please don't hesitate to contact me.

Sincerely,

Jean R. Belair, Jr.
Associate Director

JRB/jd

EXHIBIT 2

Introduced by: City Manager Edward M. Curtin, Jr.

HEADING AND PURPOSE

ORDINANCE AUTHORIZING $3,000,000 BONDS TO PROVIDE FUNDS FOR THE SHARE OF THE CITY OF HARTFORD TOWARD THE TOTAL COST OF THE PARK RIVER FLOOD CONTROL PROJECT OF THE UNITED STATES GOVERNMENT.

COURT OF COMMON COUNCIL,
CITY OF HARTFORD,

July 8, 1974

Be It Ordained by the Court of Common Council of the City of Hartford:

Section 1. The sum of three million dollars ($3,000,000) is appropriated for the purpose of providing funds for the City's share of the Park River Flood Control Project of the United States Government. The flood control works are to consist of the completion of the Park River Conduit, the construction of an auxiliary conduit, pumping stations, headwalls, dikes, sewers, drains, and appurtenances, and will require the acquisition of property, taking permanent and temporary rights-of-way, easements, excavation and slope rights, relocation of various sewer, drain and utility lines, and the reconstruction of streets, together with any planning, legal, engineering, architects' fees, or other special non-administrating costs incidental to the foregoing.

Section 2. To meet said appropriation bonds of the City shall be issued in one or more series in an aggregate principal amount of three million dollars ($3,000,000) or so much thereof as shall be necessary for such purpose. The bonds of each series shall mature in substantially equal annual installments not more than twenty (20) years from date of issue and shall bear interest payable semiannually. They shall be issued in bearer form with interest coupons attached, be registrable as to principal only, be in the denomination of $1,000 or a whole multiple thereof, be numbered from 1 consecutively upwards in the order of their maturity, be payable at and certified by a bank or trust company with a principal office in Hartford, be signed in the name and on behalf of the City by the City Manager, whose signature may be a facsimile, and the City Treasurer, and be sealed with a facsimile of the City seal. The interest coupons shall bear the facsimile signature of the City Treasurer. The date and time of issue of each series of bonds, the aggregate principal amount thereof, the annual installments of principal thereof, the bank or trust company at which such bonds shall be payable and the certifying bank shall be determined by the Court of Common Council, and the interest rate on such bonds shall be fixed by the Court of Common Council at or after the sale thereof on the basis of the accepted bid.

Section 3. The bonds shall be numbered from 1 consecutively upwards in the order of their maturity and shall be issued in substantially the following form:

COPIES SENT TO ALL COUNCILMEN

CD662

Issue No. .....
CITY OF HARTFORD
FLOOD CONTROL BOND, SERIES .....

The CITY OF HARTFORD, Connecticut, for value received, promises to pay to bearer or, if this bond shall be registered, to the holder hereof registered according to the conditions endorsed hereon

THOUSAND DOLLARS

on the day of , with interest meanwhile at the rate of per centum (%) per annum, payable semiannually on the days of and in each year, to the bearer of the respective coupons therefor hereto attached, both principal and interest being payable at the principal office of in said City of Hartford.

This bond is one of an issue of $ bonds of like tenor except as to number and maturity issued pursuant to the City Charter (No. 30 of the Special Acts of 1947 as amended), the General Statutes of Connecticut, and an ordinance duly adopted by the Court of Common Council and approved by the electors of the City.

It is hereby certified that every requirement of law relating to the issue hereof has been duly complied with and that this bond is within every debt and other limit prescribed by law or by the City. The full faith and credit of the City are pledged to the payment of the principal and interest hereof.

This bond shall not be valid unless certified hereon by

IN WITNESS WHEREOF, the City of Hartford has caused a facsimile of its seal to be hereto affixed and this bond to be signed by the facsimile signature of its City Manager and the manual signature of its City Treasurer and the attached coupons to bear the facsimile signature of its City Treasurer, all as of the day of , 19 .

CITY OF HARTFORD

By
City Manager

[SEAL]

And
City Treasurer

[Coupon]

No. $

On the day of , the CITY OF HARTFORD, Connecticut, will pay to bearer the amount specified hereon at the principal office of , in Hartford, Connecticut, for interest on its Flood Control Bond, Series , No. dated 19 .

City Treasurer

CERTIFICATE OF

.....(Bank)

This is to certify that this bond is one of the particular issue described therein, that the facsimile signature of the City Manager thereon has been adopted by him as his signature, the manual signature of the City Treasurer is genuine, the facsimile seal thereon is a facsimile of and has been adopted by the City as its genuine seal, the legal opinion hereon is a true and correct copy, except for the omission of the date, of the opinion of Adinolfi, O'Brien & Hayes, P. C., Bond Counsel of Hartford, Connecticut, which was dated as of the date of the original issue of said bonds.

_____(Bank)

By_____
Authorized Officer

[Provision for Registration]

This bond may be registered in the holder's name on the books of *and such* registration shall be noted hereon, and thereafter no transfer hereof shall be effectual unless made upon the said books by the registered holder or his attorney and noted hereon, unless the last transfer shall have been to bearer, after which it shall become transferable by delivery, but may again from time to time be registered and discharged from registry; but the coupons hereto attached shall be payable to bearer and negotiable by delivery notwithstanding the registry of this bond.

Date of Registry	In Whose Name Registered	Signature of Registrar
.....	.....	.....
.....	.....	.....

Section 4. The City Manager and City Treasurer are hereby authorized to sell said bonds at public sale on sealed bids, from time to time, in one or more series. An advertisement of each sale shall be published at least seven days before the date of sale in The Bond Buyer. Such advertisement shall require bidders to state in their bids a single rate of interest in a multiple of 1/10 or 1/20 of 1% per annum for all such bonds then being sold and the bonds shall be sold to the highest responsible bidder at the lowest net interest cost to the City, but for not less than par and accrued interest and the City shall reserve the right to reject all bids. The City Treasurer shall deliver the bonds and receive the proceeds thereof accordingly. Adinolfi, O'Brien & Hayes, P. C., Bond Counsel of Hartford, Connecticut, shall render an opinion approving the legality of such particular issue.

Section 5. The estimated cost of the improvement is sixty-four million, seven hundred thousand dollars ($64,700,000), sixty-one million, seven hundred thousand dollars ($61,700,000) of which is estimated to be paid by the United States Government. The estimated life of said improvement is forty (40) years.

Section 6. The issue of the bonds aforesaid and of all other bonds of the City heretofore authorized but not yet issued, as of the effective date of this ordinance, would not cause the indebtedness of the City to exceed any debt limit prescribed by law.

Section 7. The principal of and the interest on said bonds shall be paid from property taxes to the extent not paid from other funds available for the payment thereof, and the full faith and credit of the City are pledged to such payment.

Section 8. In anticipation of the receipt of proceeds from sale of such bonds the issue of temporary notes of the City from time to time, in an amount not to exceed $3,000,000 is hereby authorized. The City Treasurer on the recommendation of the City Manager is hereby authorized to determine the amount, date maturity, interest rate, form and other details of such notes and to sign, sell and deliver the same on behalf of the City.

Section 9. This ordinance shall take effect upon its adoption by the Court of Common Council and its approval by the electors of the City in accordance with the provisions of the Charter of the City in such case made and provided.

Adopted at a regular meeting of the Court of Common Council, August 12, 1974, by a roll-call vote 7 to 0, and approved by the Mayor, August 13, 1974.

Attest:

Robert J. Gallivan

ROBERT J. GALLIVAN,
City Clerk.

EXHIBIT 3
PAGE 4 OF 4

APPENDIX B

TYPICAL EXPLORATIONS

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site PARK RIVER CONDUIT EXT. HARTFORD, CONN. Page 1 of 6 Pages

Hole No. FD-2 Desig. P4-2 Diam. (Casing) NX F.C.

Co-ordinates: N 149,557 E 143,344

Elevation Top of Boring 53.1 M.S.L.
Total Overburden Drilled 43.8 Feet
Elevation Top of Rock 9.3 M.S.L.
Total Rock Drilled 20.2 Feet
Elevation Bottom of Boring -10.9 M.S.L.
Total Depth of Boring 64.0 Feet
Core Recovered 78.2 % No. Boxes 2
Core Recovered 10.8 Ft : NX Diam. 2⅛ In.
Soil Samples 2½ In. Diam. 1 No.
Soil Samples 2 In. Diam. 1⅛ No.

Hammer Wt. 350# Boring Started 1/25/72
Hammer Drop 18" Boring Completed 2/9/72
Casing Left NONE
Avg. Subsurface Water Depth ____ Elev. ____
Obs. Well NONE (FINNERTY)
Drilled By U.S. ARMY CORP OF ENGS.
Mfg. Des. Drill CP-3
Inspected By: W. SWIFT
Classification By: [redacted]
AMPLIFICATIONS BY LABORATORY CLASSIFIER [redacted] MB

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
0.8'	NO SAMPLE	2½"	0.0 0.8	3	DROVE 2½" IDX5' SOLID SPOON FROM	No Sample
				10	0.0' TO 5.0' & TOOK SAMPLE. 40% REC; HOLE OPEN TO 5.0	Varved, reddish-brown, CLAY (CL), and light brown to tan, SILT (ML), layers ranging from paper thickness to approx. ⅛" thickness, with occasional pieces of gravel, and vegetation
2	J1 (2 JARS)	2½"	0.8' 5.0'	23		
				27		
4				35	DROVE 2" IDX5' SOLID SPOON FROM 5.0' TO	
5.0'				8	10.0' & TOOK SAMPLE 100% REC'Y.	Medium compact and medium stiff, reddish-brown, varved CLAY (CH), and lt. tan to brown & reddish-brown, SILT (ML); layers vary in thickness from paper thickness to 1", occ. very thin (too thin for megascopic measurement) sandy strata.
6				13	JETTED NX FLUSH CASING FROM 0.0' TO 10.0'	
8	J2 (2.5 JARS) B3	2"	5.0' 10.0	19		
				22		
10.0'				30		

GENERAL REMARKS: BORING LOCATED ON GRASSY AREA, ON SLOPE, WITH SCATTERED HARDWOODS IN AREA.

Site: PARK RIVER CONDUIT EXT. HARTFORD, CONN.

Boring No. FD-2

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
1" = 2'						
				4	DROVE 2" IDX5' SOLID SPOON FROM 10.0' TO 15.0' & TOOK SAMPLE. 100% REC.	Medium compact and medium st. fs, reddish-brown, varved CLAY(CH), and lt. tan to brown grayish-brown SILT (ML); layers vary in thickness from paper thickness to approx. 1", occ. very thin (too thin for megascopic measurement) sandy strata.
				6		
12	J4 (2JARS) B5	2"	10.0' 15.0'	7	JETTED NX FLUSH CASING FROM 10.0' TO 15.0'	
				9		
14				11		
15.0'				WT. OF TOOLS	DROVE 2" IDX5' SOLID SPOON FROM 15.0' TO 20.0' & TOOK SAMPLE. 100% REC.	
16				1		
				2		
	J6 (2JARS) B7	2"	15.0' 20.0'	3	JETTED NX FLUSH CASING FROM 15.0' TO 20.0'	
18				4		
				5		
20				WT. OF TOOLS	DROVE 2" IDX5' SOLID SPOON FROM 20.0' TO 25.0' & TOOK SAMPLE. 100% REC.	
22	J8 (2JARS) B9	2"	20.0 - 25.0	WEIGHT OF TOOLS PLUS HAMMER 2	JETTED NX FLUSH CASING TO 25.0'	
				5	DROVE 2" IDX5' SOLID SPOON FROM 25.0' TO 30.0' & TOOK SAMPLE. 100% REC.	
24				6		
25				3	JETTED NX FLUSH CASING FROM 25.0' TO 30.0'	
26	J10 (2JARS) B11	2"	25.0' 30.0'	3		

Site: PARK RIVER CONDUIT EXT. HARTFORD, CONN. | Boring No. FD-2 | Page 3 of 6

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
0 to 2'				3 / 4 / 6	DROVE 2" I.D. X 5' SOLID SPOON FROM 30.0' TO 35.0' & TOOK SAMPLE.	
30.0'					100% REC'Y.	
				WEIGHT OF TOOLS	JETTED NX FLUSH, CASING FROM 30.0' TO 35.0'	
	J12 (2 JARS) B13	2"	30.0' 35.0'	3 / 3 / 4	DROVE 2" I.D. X 5' SOLID SPOON FROM 35.0' TO 40.0' & TOOK SAMPLE. 80% REC'Y.	
35.0'				WT. OF TOOLS PLUS HAMM. / 9	JETTED NX FLUSH, CASING FROM 35.0' TO 40.0'	
36.7'	J14 (2 JARS)	2"	35.0' 36.7'			
	J15	2"	36.7' 40.0'	9 / 39 / 82 / 94		STIFF TO VERY HARD, REDDISH-BROWN, GRAVELLY, SANDY, SILTY CLAY (CL-ML)
40.0'					CONTINUED ON PAGE 4 →	

Site: PARK RIVER CONDUIT EXT. HARTFORD, CONN.	Boring No. FD-2	Page 4 of 6

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
					CONTINUED FROM Pg. 3 →	
40.0'	J16	2"	40.0' 43.8'	36 / 71 / 77	DRIVE 2" ID X 5' SOLID SPOON FROM 40.0' TO 43.8' & TOOK SAMPLE. 100% REC. REFUSAL @ 43.8' 100 BLOWS NO PENETRATION. DRILLED NX FLUSH CASING FROM 40.0' TO 43.8' W/NX DIAMOND SHOE.	Stiff to very hard, reddish-brown, gravelly (10-20), sandy (30-40), silty CLAY, (CL-ML)
43.8'	J17	2"	43.8' 43.8'	210	ROTARY DIAMOND DRILLED NX 5.0' "M" SERIES CORE BARREL FROM 43.8' TO 45.7' FEED 300 P.S.I. TIME 98 MIN. WATER RED BROWN HOLDING BLOCKED. NX "M" BIT # 91R1047	Weathered Rock TOP OF ROCK
45.7'	Box #1	NX "M"	43.8 45.7	RUN 1.9 REC. 1.3 68%		SHALE, red moderately hard fine grained, unweathered to slightly weathered w/ numerous clay filled and calcite coated joints which dip at 60° to 70°. Very thin, fine grained Cross-bedded sandstone zones 50.0' to 57.0'. Major bedding is obscure but essentially horizontal. Calcareous 70° dip joints at 53.0', 54.0', 54.9' and 55.4'. Voids along joints 1/8" to 1/4" wide.
46.6				RUN 0.9 REC. 0.7 43%	FEED 300 P.S.I. TIME 20 MIN. BLOCKED WATER RED BROWN HOLDING NX "M" SERIES #91R1047	
	Box #1	NX	46.6 49.9	RUN 3.3 REC. 2.1 63%	ROTARY DIAMOND DRILLED NX 5.0' CORE BARREL FROM 46.6' TO 49.9' FEED 300 P.S.I. TIME 40 MIN. BLOCKED WATER REDISH BROWN HOLDING. NX BIT # 03B65	
49.9'	Box #1	NX	49.9 54.9	RUN 5.0' REC. 4.1 82%	ROTARY DIAMOND DRILLED NX 5.0' CORE BARREL FROM 49.9' TO 54.9'. 100% LOSS OF WATER @ 53' FEED 300 P.S.I. TIME 45 MIN. WATER REDISH BROWN HOLDING TO 100% LOSS @ 53' NX BIT # 03B65	
54.9'	Box #1	NX	54.9 57.1		FROM 54.9' TO 69.1'	

Site: RK RIVER CONDUIT EXT. HARTFORD, CONN.

Boring No. FD-2

Page 5 of 6

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
					FEED 300 P.S.I.	
					TIME 50 MIN.	
				RUN	WATER LOSING 100%	
			54.9'	4.2	BLOCKED.	
	BOX #1	NX	59.1'	REC.	NX BIT # 03865	
				4.0		
					ROTARY DIAMOND DRILLED FROM	
					59.1' TO 60.0' BLOCKED.	Thick, soft
				95%	FEED 300 P.S.I.	weathered clay
					TIME 20 MIN.	
59.1'					WATER LOSING 100%	Zone 59.1 to
	BOX #2	NX	59.1'	RUN 0.9 REC. 0.9 95%	NX BIT # 03865	60.0' Irregular
			60.0'		ROTARY DIAMOND DRILLED	vertical joint
60.0'					NX 5.0' CORE BARREL	63.0' to 64.0'.
					FROM 60.0' TO 64.0'	
					END OF RUN.	
				RUN	FEED 300 P.S.I.	
				4.0	TIME 55 MIN.	
			60.0'		WATER-LOSING 100% TO	
	BOX #2	NX	64.0'	REC.	RETURN @ 60.3' & IMMEDIATE	Water Loss 100%
				3.4	LOSS AGAIN @ 60.3'	53.0' to 63.5'
					RETURNING @ 63.5' REDISH	
				85%	BROWN & HOLDING.	
64.0'						
					BOTTOM OF EXPLORATION @ 64.0'	
					BOTTOM ELEVATION PREDETERMINED	

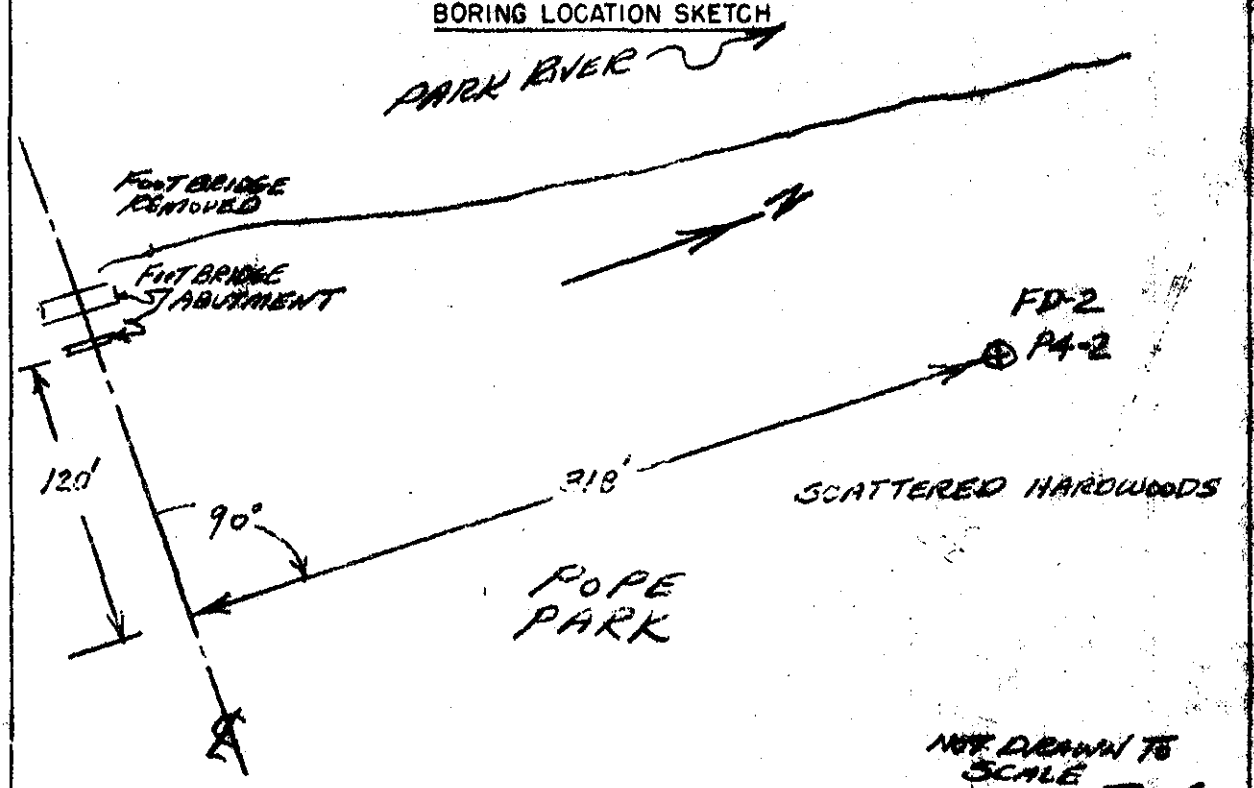
Site: HARTFORD, CONN.
Boring No: FD-2

SUBSURFACE WATER OBSERVATIONS

DATE	TIME	DEPTH-BOT. OF CASING	DEPTH-BOT. OF BORING	DEPTH TO WATER	ELEVATION WATER	REMARKS
1/25	1600	10.0'	10.0'	DRY		READING AFTER DRIVING CASING
1/26	0800	10.0'	10.0'	DRY		READING BEFORE CLEANING CASING
1/26	1600	25.0'	25.0'	0.4'		READING 25 MIN. AFTER DRILLING
1/27	0800	25.0'	25.0'	5.1'		READING BEFORE DRILLING
1/27	1600	40.0'	42.8'	1.4'		READING 15 MIN. AFTER DRILLING
2/2	1200	43.8'	49.9'	27.7'		READING 30 MIN. AFTER DRILLING
2/3	0800	43.8'	60.0'	51.5'		READING BEFORE DRILLING

Note: Depths are in feet below original ground

BORING LOCATION SKETCH



B-6

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site PARK RIVER CONDUIT E. T. HARTFORD, CONN. Page 1 of 5 Pages

Hole No. FD3 Desig. CP-3 Diam. (Casing) NX F.C.

Co-ordinates: N 149,138 E 143,092

Elevation Top of Boring 39.1 M.S.L. Hammer Wt. 350# Boring Started 3/17/72

Total Overburden Drilled 33.2 Feet Hammer Drop 18" Boring Completed 3/23/72

Elevation Top of Rock 5.9 M.S.L. Casing Left NONE

Total Rock Drilled 16.8 Feet Avg. Subsurface Water Depth _____ Elev. _____

Elevation Bottom of Boring -10.9 M.S.L. Obs. Well NONE (FINNERTY)

Total Depth of Boring 50.0' Feet Drilled By U.S. ARMY CORP OF ENGR. N.E.D.

Core Recovered 84.5 % No. Boxes 2 Mfg. Des. Drill CP-3

Core Recovered 14.2' Ft. NX Diam. 2 1/8 In. Inspected By: W. SWIFT

Soil Samples 2" In. Diam. 8 No. Classification By: [redacted]

Soil Samples 2 1/2" In. Diam. 1 No. Classification By: AMPLIFICATIONS BY LABORATORY CLASSIFIER: [redacted]

DEPTH 1"=2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
				40	DROVE 2 1/2" IDX5' SOLID SPOON FROM 0.0' TO 5.0' & TOOK SAMPLE. 25% REC'Y. HOLE OPEN T. 5.0'	Loose, reddish-brown, silty, sandy, GRAVEL, pieces of brick and glass, moist, (Fill).
				18		
2	J1	2 1/2"	0.0' 5.0'	17		
				20		
4				24		
5.0'						
				6	DROVE 2" IDX5' SOLID SPOON FROM 5.0' TO 10.0' & TOOK SAMPLE. 25% REC'Y. JETTED NX FLUSH CASING FROM 0.0' TO 10.0'	Soft, reddish brown, gravelly, sandy, clayey SILT, layer of silty CLAY, with layer of Ashes, moist, (Fill)
6				7		
	J2	2"	5.0' 10.0'	8		
8				10		
				11		
10.0'						

GENERAL REMARKS: BORING LOCATED ON FILL AREA AT TOP OF EMBANKMENT.

Site: Fm : River Conduit Ext. Hartford, Conn. | Boring No. FD-3 | Page 2 of 5

DEPTH		CORE/SAMPLE NO.	SIZE		BLOWS PER FOOT OR CORE RECOVERY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	1'-2'						
10.8'		J3	2"	10.0' 10.8'	3	Drove 2" ID x 5' Solid Spoon from 10.0' to	Soft, reddish-brown clayey SILT (ML), and gray silty CLAY (CL) stratified or varved with roots and pieces of wood mostly, (Probable Fill material)
					—	15.0' & took Sample. 70% Rec'y. Jetted NX Flush Casing from 10.0' to 15.0'	
		J4 (2 Jars)	2"	10.8' 15.0'	4		
					3		
					5		Soft, reddish-brown sandy, clayey, SILT (ML) and gray-brown, silty CLAY (CL), stratified layers, moist, roots
15.0'					7		
					WEIGHT OF TOOLS AND HAMMER	Drove 2" ID x 5' Solid Spoon from 15.0' to 20.0' & took Sample. 65% Rec'y. Jetted NX Flush Casing from 15.0' to 20.0'	Soft, stratified layers of brown sandy SILT (ML), and layers of F (roots, leaves) organics, moist to wet.
		J5 (3 Jars)	2"	15.0' 20.0'	2		
					6		
					7		
					7	Drove 2" ID x 5' Solid Spoon from 20.0' to	
20.0'		J6 (2 Jars)	2"	20.0' 21.0'	1	28.0' & took Sample. 60% Rec'y.	same as above.
21.0'					2	Jetted NX Flush Casing from 20.0' to 21.0'	Soft, reddish-brown gravelly, sandy, CLAY (CL), moist.
					3		
		J7 (2 Jars)	2"	21.0' 25.0'	5		
					6	Drove 2" ID x 5' Solid Spoon from 25.0' to 30.0' & took Sample.	
25.0'					24	20% Rec'y. Jetted NX Flush Casing from 25.0' to 30.0'	same as above
		J8	2"	25.0' 30.0'	39		

FORM MAR 71 SBA (Test)

Boring No. FD-3

Site: PA · RIVER CONDUIT EXT. HARTFORD, CONN. | Boring No. FD-3 | Page 3 of 5

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. — CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
28		2"	25.0' 30.0'	31 52		Same as above
30.0'				95	DROVE 2" ID X 5' SOLID SPOON FROM 30.0' TO 33.0' REFUSAL @ 33.0	
	J9	2"	30.0 33.0	25 87	100 BLOWS NO PENETRATION. TOOK SAMPLE, 30% RECY. CHOPPED & WASHED FROM 33.0' TO 33.2', WASH SPOON BOUNCING @ 33.2'	Compact, reddish-brown, sandy, clayey GRAVEL (GC), Till, moist.
32				141	JETTED NX FLUSH CASING FROM 30.0' TO 33.2'	
33.0'			33.0			Top of Rock ?
33.2'	Shale		33.2			
34				RUN 5.0'	ROTARY DIAMOND DRILLED NX 5.0' CORE BARREL, FROM 33.2' TO 38.2' END OF RUN @ 38.2' FEED 300 P.S.I. TIME 90 MIN. WATER REDISH BROWN HOLDING. NX BIT # 03B65	SHALE, red-brown moderately hard fine grained, fresh. Scattered, slightly weathered joints dip 45° ± throughout. Zones of thin-cross-bedded sandstone. Locally calcareous Bedding generally obscure but where apparent dip 22° ±.
36	Box #1	NX	33.2' 38.2	REC. 4.3' 86%		
38					ROTARY DIAMOND DRILLED NX 5.0' CORE BARREL	
38.2'				RUN 3.4	FROM 38.2' TO 41.6' BLOCKED @ 41.6' FEED 300 P.S.I. TIME 70 MIN. WATER REDISH BROWN HOLDING. NX BIT # 03B65	
40	Box #1	NX	38.2 41.6	REC. 2.2 65%		
41.6'					ROTARY DIAMOND DRILLED	
	Box #1	NX	41.6 46.1	RUN 4.5 REC 3.9 89%	NX 5.0' CORE BARREL FROM 41.6' TO 46.1' BLOCK @ 46.1 FEED 300 P.S.I. TIME 75 MIN. WATER REDISH BROWN HOLDING. NX BIT # 03B65	

NED FORM 56A (Test) MAR 71

Boring No. FD-3

Site: PA. R. RIVER CONDUIT EXT. HARTFORD, CONN.	Boring No. FD-3	Page 4 of 5

DEPTH		CORE/SAMPLE			BLOWS PER FT. CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	r=2'	NO.	SIZE	DEPTH RANGE			
		Box #1	NX	41.6 46.1		ROTARY DIAMOND DRILLED NX 5.0' CORE BARREL	Soft clay in fracture zones 49.4' to 49.8'
46.1'					RUN 9.9	FROM 46.1' TO 50.0' BLOCKED @ 50.0' FEED 300 P.S.I. TIME 90 MIN. WATER-REDISH BROWN HOLDING. NX BIT # 03865	
		Box #2	NX	46.1' 50.0	REC. 3.8		
					97%		
50.0'						BOTTOM OF EXPLORATION BOTTOM ELEVATION PREDETERMINED.	

PARK RIVER CONDUIT EXT.

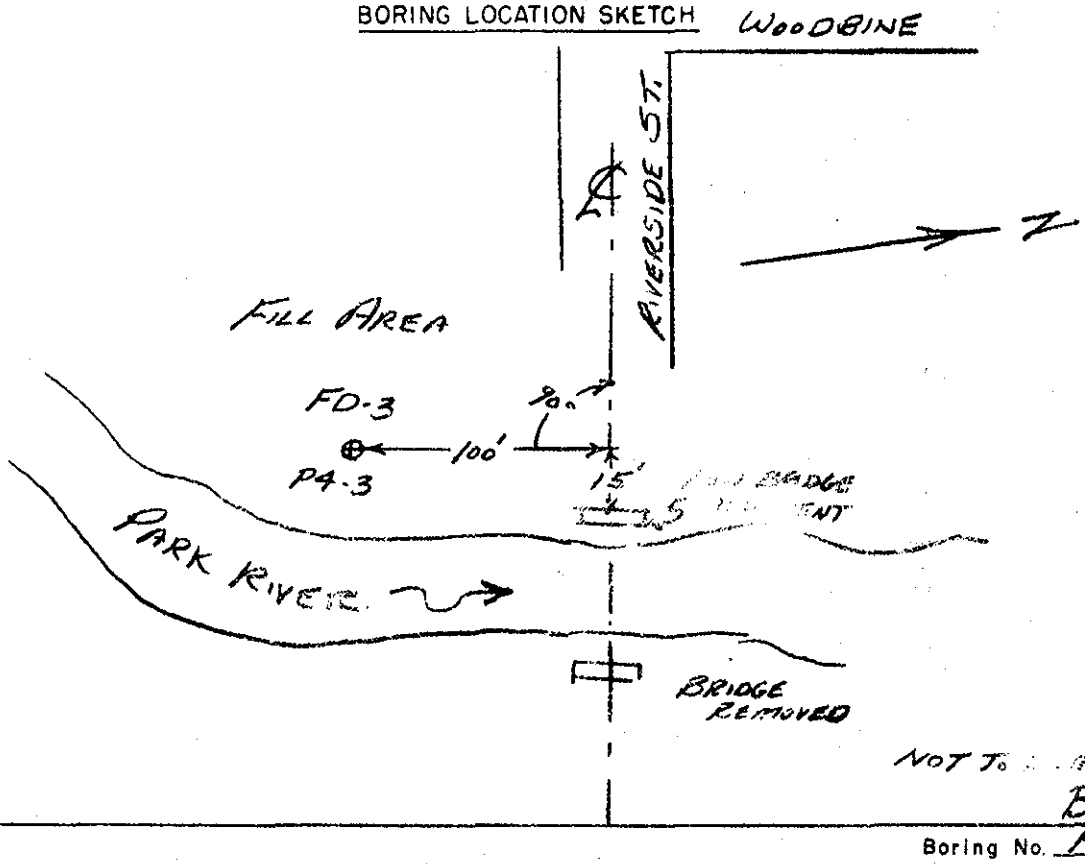
Site: HARTFORD, CONN.
Boring No: FD-3

SUBSURFACE WATER OBSERVATIONS

DATE	TIME	DEPTH-BOT. OF CASING	DEPTH-BOT. OF BORING	DEPTH TO WATER	ELEVATION WATER	REMARKS
2/18	1600	33.2'	38.2'	12.6'		READING 30 MIN. AFTER DRILLING.
2/22	0800	33.2'	38.2'	13.2'		READING BEFORE DRILLING
2/23	0800	33.2'	38.2'	12.8'		READING BEFORE DRILLING
2/23	1600	33.2'	50.0'	9.9'		READING 15 MIN. AFTER DRILLING.
2/24	0800	33.2'	50.0'	11.8'		READING BEFORE PULLING CASING.

Note: Depths are in feet below original ground

BORING LOCATION SKETCH



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U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site PARK RIVER CSO OUTFALL EXT. HARTFORD, CONN. Page 1 of 5 Pages
Hole No. FD-2 Desig. P-1 Diam. (Casing) NXF.C.
Coordinates: N 142,542 E 163,116

Elevation Top of Boring 36.6 M.S.L. Hammer Wt. 350# Boring Started 5/30/72
Total Overburden Drilled 39.0 Feet Hammer Drop 18" Boring Completed 5/6/72
Elevation Top of Rock -2.4 M.S.L. Casing Left NONE
Total Rock Drilled 21.0 Feet Avg. Subsurface Water Depth ____ Elev. ____
Elevation Bottom of Boring -23.4 M.S.L. Obs. Well NONE (FINNERTY)
Total Depth of Boring 60.0' Feet Drilled By U.S. ARMY CORPS OF ENGR.
Core Recovered 79.5% No. Boxes 2 Mfg. Des. Drill SPN 750 C
Core Recovered 16.7 Ft. NX Diam. 2⅛ in. Inspected By: SWIFT
Soil Samples 2½ in. Diam. 1 No. Classification By: [redacted]
Soil Samples 2 in. Diam. 10 No. Classification By: AMPLIFICATIONS BY LABORATORY CLASSIFIER [redacted]

DEPTH 1"=2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
0.4	NO SAMPLE	NO SAMPLE	2½" 0.0 0.4		DROVE 2½" I.D. X 5' SAMPLER	Bituminous Concrete
	J1	2½"	0.4' 5.0'	111	SPOON FROM 0.0' TO 5.0' & TOOK SAMPLE. 50% REC. HOLE OPEN TO 5.0'	Compact, brown & dark brown, sandy SILT, Gray-brown layer of clay, brick, ashes, coal, moist, (FILL)
				47		
				28		
				26		
				51		
5.0' 5.3	J2	2"	[redacted]		DROVE 2" I.D. X 5' SAMPLER	Concrete pcs and metal (FILL)
				10	SPOON FROM 5.0' TO 10.0' & TOOK SAMPLE. 20% REC'Y. JETTED NX FLUSH CASING FROM 0.0' TO 10.0'	Loose to med. compact reddish-brown, sandy SILT (ML) moist.
	J3 (STAND)	2"	5.3' 10.0'	10		
				15		
				20		
				27		

GENERAL REMARKS: BORING LOCATED ON FLAT FILL AREA ADJACENT TO PARK RIVER.

FORM 1AR 71 (Test) Boring No. FD-2 R-12

Site:	Boring No.	Page
RIVER CONDUIT EXT. HARTFORD, CONN.	FD-4	of 2

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH	BLOWS PER FT.	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
12	J4 (JARS)	2"	10.0'–15.0'	13, 17, 24, 22, 29	DROVE 2" IDX5' SOLID SPOON FROM 10.0' TO 15.0' & TOOK SAMPLE. 70% REC'Y. JETTED NX FLUSH CASING FROM 10.0' TO 15.0'	Medium compact, reddish-brown, sandy, clayey, SILT, (ML), moist.
15.0' – 20.0' (16, 18)	J5 (JARS) B6	2"	15.0'–20.0'	WEIGHT OF TOOLS; WEIGHT OF TOOLS PLUS HAMMER	DROVE 2" IDX5' SOLID SPOON FROM 15.0' TO 20.0' & TOOK SAMPLE. 100% REC'Y. JETTED NX FLUSH CASING FROM 15.0' TO 20.0'	Soft, reddish-brown silty CLAY (CH), stratified with thin layers of SILT (ML), very sticky, moist. W.C. { CLAY = 62.1%; SILT = 50.4% }
20.0' – 21.5'	J7 (JARS)	2"	20.0'–21.5'	WEIGHT OF TOOLS	DROVE 2" IDX5' SOLID SPOON FROM 20.0' TO 25.0' & TOOK SAMPLE. 80% REC'Y. JETTED NX FLUSH CASING FROM 20.0' TO 25.0'	same as above W.C. { ClAY = 63.0%; SILT = 46.0% }
21.5' – 25.0' (22, 24)	J8 (JARS)	2"	21.5'–25.0'	PLUS HAMM., 6, 20, 38	DROVE 2" IDX5' SOLID SPOON FROM 25.0' TO 30.0' & TOOK SAMPLE. 70% REC'Y.	Soft to Med. compact reddish-brown silty-clayey, gravelly SAND (SC), moist to wet (Till)
25.0' (26)	J9 (JARS)	2"	25.0'–30.0'	10, 19	JETTED NX FLUSH CASING FROM 25.0' TO 30.0'	same as above W.C. = 11.7%

Site: PARK RIVER CONDUIT EXT. HARTFORD, CONN.

Boring No. FD-4

Page 3 of 6

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. — CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
28		2"	25.0' 30.0'	35 62 73	DRIVE 2" ID X 5' SOLID SPOON FROM 30.0' TO 35.0' & TOOK SAMPLE. 40% REC'Y.	same as above
30.0'				46 47	JETTED NX FLUSH CASING FROM 30.0' TO 35.0'	Compact, reddish-brown, silty, gravelly, SAND (SM), moist (TILL)
	J10 (2 JARS)	2"	30.0' 35.0'	40 36 90	DRIVE 2" ID X 5' SOLID SPOON FROM 35.0' TO 96.8' & TOOK SAMPLE. SAMPLE SPOON BOULDING, CHOPPED & WASHED FROM 36.8' TO 97.3'	W.C. = 8.9% 100% REC'Y.
35.0	J11 (2 JARS)	2"	35.0 36.8	130 275	JETTED NX FLUSH CASING FROM 35.0' TO 37.3'	same as above.
36.8'	NO SAMPLE		36.8 37.8		ROTARY DIAMOND DRILLED FROM 37.3' TO 40.0'	
37.3'	Box #1	NX	37.3' 39.0'	8" 0 16" 0	W/NX 5' CORE BARREL FEED 175 LBS. TIME 26 MIN. WATER GREY BROWN MUDDING. BLOCKED @ 40.0'	
39.0'	Box #1	NX	39.0' 40.0'	1' 10" 0 REC. 0.7 70%	NX BIT # 81B161	
40.0'					ROTARY DIAMOND DRILLED W/ NX 5' CORE BARREL FROM 40.0' TO 45.0' FEED 175 LBS. TIME 40 MIN. WATER GREY BLACK & WHITE MIXED. END OF RUN @ 45.0' NX BIT # 81B161	SHALE, dark gray, moderately hard, very fine grained, unweathered slightly weathered along widely scattered joints which dip at 60°. Bedding obscure.
	Box #1	NX	40.0 45.0	RUN 5.0' 40.0 REC. 4.2' 84%		

FORM SBA (Test)

Boring No. FD-4

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Site: PARK RIVER CONDUIT EXT. HARTFORD, CONN.

Boring No. FD-4

Page 4 of 5

DEPTH		CORE/SAMPLE			BLOWS PER FT. CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	F. 2'	NO.	SIZE	DEPTH RANGE			
				40.0 45.0			
45.0'						ROTARY DIAMOND DRILLED NX 5' CORE BARREL FROM 45.0' TO 50.0' FEED 175 LBS. TIME 25 MIN. WATER - GREY BLACK & WHITE MIXED, HOLDING END OF RUN @ 50.0' NX BIT # 81B161	Color change to black 48.3' to 50.0' Slightly weathered zone @ 53.6
					RUN 5.0		
		BOX #1	NX	45.0' 50.0'	REC. 2.7		
					54%		
50.0'						ROTARY DIAMOND DRILLED NX 5' CORE BARREL FROM 50.0' TO 55.0' FEED 175 LBS. TIME 34 MIN. WATER - GREY W/BROWN STREAKS HOLDING END OF RUN @ 55.0' NX BIT # 81B161	
					RUN 5.0		
		BOX #2	NX	50.0' 55.0'	REC. 4.8		
					96%		
55.0'						ROTARY DIAMOND DRILLED NX 5' CORE BARREL FROM 55.0' TO 60.0' FEED 175 LBS. TIME 25 MIN. WATER - GREY TO REDISH BROWN HOLDING END OF RUN @ 60.0' NX BIT # 81B161	SANDSTONE light gray, moderately hard, unweathered. Conspicuous cross-bedding with variable dips. Calcareous. SHALE, red-brown moderately hard fine grained unweathered. Weathered vertical seam at 58.0' scattered thin veins of calcite.
					RUN 5.0		
		BOX #2	NX	55.0' 60.0'	REC. 4.3		
					86%		
60.0'						BOTTOM OF EXPLORATION @ 60.0 BOTTOM ELEVATION PREDETERMINED.	

PARK RIVER CONDUIT EXT.

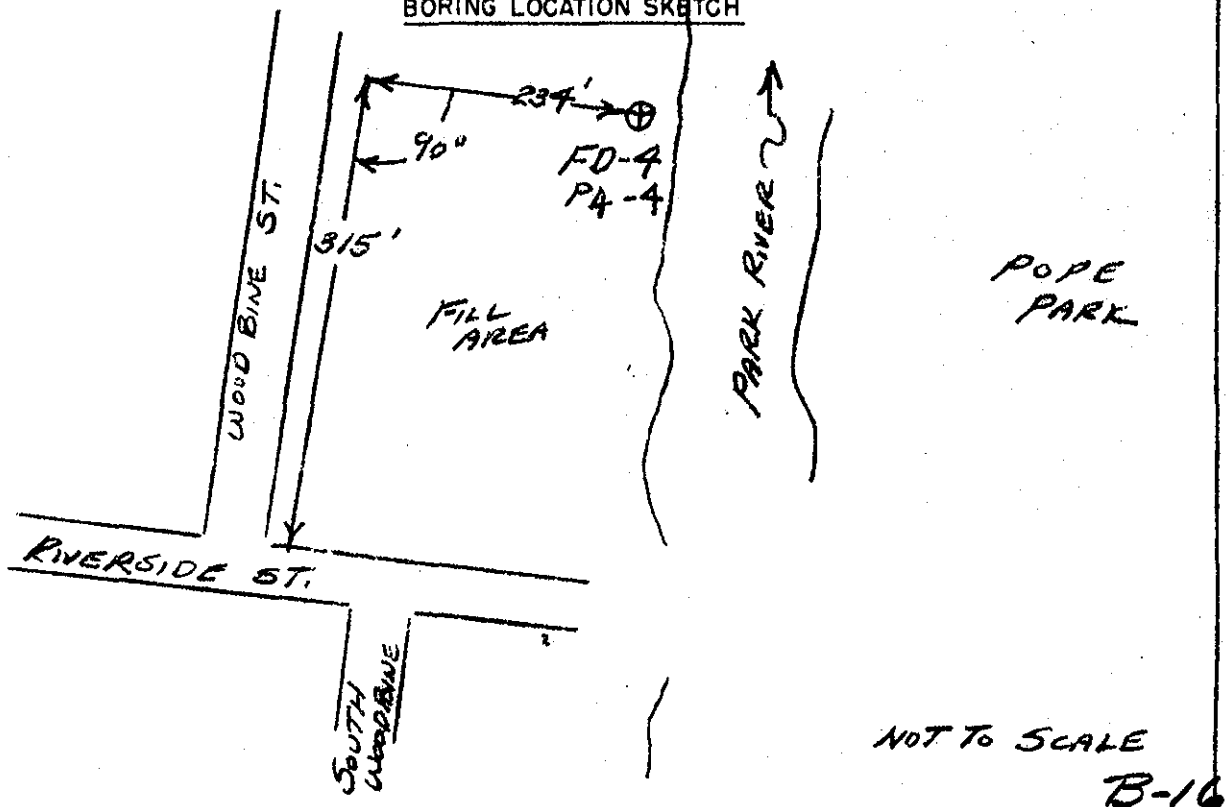
Site: HARTFORD, CONN.
Boring No: FD-4

SUBSURFACE WATER OBSERVATIONS

DATE	TIME	DEPTH-BOT. OF CASING	DEPTH-BOT. OF BORING	DEPTH TO WATER	ELEVATION WATER	REMARKS
2/29	1600	25.0'	25.0'	0'6'		READING 15 MIN. AFTER DRILLING
3/1	0800	25.0'	25.0'	11.5'		READING BEFORE DRILLING
3/1	1600	37.3'	37.3'	6.8'		READING 15 MIN. AFTER DRILLING.
3/2	0800	37.3'	37.3'	15.6'		READING BEFORE DRILLING
3/2	1600	37.3'	50.0'	9.0'		READING 15 MIN. AFTER DRILLING.
3/6	0800	37.3'	50.0'	11.6'		READING BEFORE DRILLING
3/6	1200	0.0	60.0'	3.8'		READING AFTER PULLING CASING.

Note: Depths are in feet below original ground

BORING LOCATION SKETCH



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PARK RIVER CONDUIT EXT.

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site HARTFORD, CONN. Page 1 of 6 Pages

Boring No. ED-5 Desig. P-#7-2 Diam. (Casing) ALL-FC

Co-ordinates: N 149,270. E 162,209

Elevation Top of Boring 39.5 M.S.L.* Hammer Wt. 350 # Boring Started 3/1/72

Total Overburden Drilled 55.2 Feet Hammer Drop 18" Boring Completed 3/16/72

Elevation Top of Rock -15.7 M.S.L. Casing Left NONE

Total Rock Drilled 18.7 Feet Subsurface Water Data _____ Page 6

Elevation Bottom of Boring -35.4 ± M.S.L. Obs. Well NONE

Total Depth of Boring 74.9 Feet Drilled By CORPS OF ENGINEERS

Core Recovered 88.3 % No. Boxes 2 Mfg. Des. Drill CP-5

Core Recovered 17.4 Ft : NX Diam. 2 1/8 In. Inspected By: A. MERRILL

Soil Samples 2 1/2 In. Dia m. 1 No. Classification By: [redacted]

Soil Samples 3 In. Diam. 1/2 No. Classification By: [redacted]

AMPLIFICATIONS BY LABORATORY CLASSIFIER [redacted]

DEPTH 1"= 2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
0	J-1 (2 JARS)	2 1/2"	0.0 TO 5.0	5	DROVE 2 1/2" I.D. 15.0' SOLID SAMPLE SPOON 0.0' TO 5.0' & TOOK SAMPLE. REC. 100%. HOLE REMAINED OPEN.	Soft, gray-brown, stratified layers of sandy, silty, CLAY (CL) moist, roots (Probable Fill)
2				8		
				10		
4				17		
5.0				18		
6	J-2 (2 JARS)	2"	5.0 TO 10.0	7	DROVE 2" I.D. 15.0' SOLID SAMPLE SPOON 5.0' TO 10.0' & TOOK SAMPLE. REC. 80%. JETTED NX-FC CSG FROM 0.0' TO 10.0'.	Same as above with coal & cinders (probable Fill)
				9		
8				13		
				12		
10.0 10				15		

GENERAL REMARKS: * TAKEN FROM PLAN CONTOURS. LOCATED NEXT TO NORTH BRANCH - PARK RIVER.

Site: PARK RIVER CONDUIT EXT. HARTFORD CONN.

Boring No. FD-5 P-7-2

Page 2 of 6

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0	J-3 (2 JARS)	2"	10.0 to 15.0	5 / 9 / 6 / 4 / 4	DROVE 2" I.D. X 5.0' SOLID SAMPLE SPOON 10.0' TO 15.0' & TOOK SAMPLE. REC. 30% ± JETTED NX-FC CSG FROM 10.0' TO 15.0'	Soft, reddish-brown, stratified layers of sandy, silty, CLAY, (CH), (small amount of Gravel), moist
15.0	J-4 (2 JARS)	2"	15.0 to 20.0	1 / 2 / 4	DROVE 2" I.D. X 5.0' SOLID SAMPLE SPOON 15.0' TO 20.0' & TOOK SAMPLE. REC. 100%. JETTED NX-FC CSG FROM 15.0' TO 20.0'	Soft, gray, sandy, SILT (ML), with roots and wood fibers, moist to wet.
18.0	J-5 (2 JARS)	2"	18.0 to 20.0	4 / 4		Soft, reddish-brown, CLAY, (CH), stratified with layers of gray SILT (ML), moist to wet. W.C. { CLAY = 59.9% SILT = 53.8%
20.0	J-6 (2 JARS) B-7	2"	20.0 to 25.0	WGT. TOOLS / 1 / WEIGHT OF TOOLS + HAMMER	DROVE 2" I.D. X 5.0' SOLID SAMPLE SPOON 20.0' TO 25.0' & TOOK SAMPLE. REC. 100%. JETTED NX-FC CSG FROM 20.0' TO 25.0'	Same as above.
25.0				WGT. TOOLS / WGT. TOOLS + HAMMER	DROVE 2" I.D. X 5.0' SOLID SAMPLE SPOON 25.0' TO 30.0' & TOOK SAMPLE. REC. 100%	

Site: PARK RIVER CONDUIT EXT. HARTFORD, CONN.

Boring No. ED 5 P-#7-2

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
27	J-8 (2 JARS)	2"	25.0 TO 30.0	WEIGHT OF TOOLS & HAMMER	JETTED NX-FC CSG from 25.0' to 30.0'.	Same as above (wet)
29	B-9					
30.0				WGT. OF TOOLS	DROVE 2" I.D. X 5.0' SOLID SAMPLE SPOON 30.0' TO 35.0' & TOOK SAMPLE. REC. 100%	
31	J-10 (2 JARS)	2"	30.0 TO 35.0	WGT. TOOLS & HAMMER		Same as above (wet)
	B-11			1	JETTED NX-FC CSG	
33				2	From 30.0' to 35.0'.	
35.0				2'		
35	J-12 (2 JARS)	2"	35.0 TO 37.9	WGT. TOOLS	DROVE 2" I.D. X 5.0' SOLID SAMPLE SPOON 35.0' TO 40.0' & TOOK SAMPLE. REC. 100%	Same as above, (wet)
	B-13			TOOLS & HAMMER 3		
37				8		
37.9					JETTED NX-FC CSG	
	J-14 (2 JARS)	2"	37.9 TO 40.0	17	From 35.0' to 40.0'.	Medium compact to compact, reddish-brown, silty-clayey, gravelly, SAND (SG), moist (Till)
39				16		
40.0				8	DROVE 2" I.D. X 5.0' SOLID SAMPLE SPOON 40.0' TO 45.0' & TOOK SAMPLE. REC. 100%	
41	J-15 (2 JARS)	2"	40.0 TO 45.0	37		Same as above W.C. 9.3%
				33		
43				58	JETTED NX-FC CSG From 40.0' to 45.0'	

Site: PARK RIVER CONDUIT EXT. HARTFORD, CONN.

Boring No. FD-5 P. #7-2

DEPTH (Ft.)	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
44				81		
45.0					DROVE 2" I.D. X 5.0' SOLID SAMPLE SPOON 45.0' TO 48.0' & TOOK SAMPLE. REC. 100%	Compact, reddish-brown, silty-clayey, gravelly, SAND (SM), moist, (TILL)
46	J-16 (2 JARS)	2"	45.0 TO 48.0	18 / 103		
48.0				341	WASHED & CHOPPED FROM 48.0' TO 49.7'. NO CHANGE IN MATL INDICATED BY WASH WATER. JETTED NX-FC CSG FROM 45.0' TO 49.7'	
49.7	WASHED & CHOPPED		48.0 TO 49.7		DROVE 2" I.D. X 5.0' SOLID SAMPLE SPOON 49.7' TO 50.0' & TOOK SAMPLE. REC. 100%	same as above
50.0	J-17	2"	49.7 TO 50.0	240	DROVE 1 1/2" I.D. X 5.0' SOLID SAMPLE SPOON 50.0' TO 52.2' & TOOK SAMPLE. REC. 100%.	same as above W.C. = 10.3%
52	J-18	1 1/2	50.0 TO 52.2	32 / 85	REFUSAL @ 52.2'	
52.2				200	ROTARY DRILLED W/NX STANDARD BIT 52.2 TO 53.0'. NO REC. - BIT #03864. WASH WATER & DRILL BEHAVIOR CONTINUED TO INDICATE SAME MATL.	
53.0	WASHED & CHOPPED	NX	52.2-53.0		JETTED NX-FC CSG FROM 49.7' TO 53.0'. WASHED & CHOPPED FROM 53.0' TO 55.0'. NO CHANGE IN MATL. JETTED NX-FC CSG FROM	
54			53.0 TO 55.0			
55.0					[illegible] 5.0' SOLID SAMPLE SPOON 55.0' TO 55.2'	same as above.
55.2	CORE BOX #1	NX	55.2 TO 57.0	RAN 1.8' REC. 1.1' 100%	REC. 100%, REF @ 55.2'. DRILLED W/NX STANDARD BIT #03864. HYD. FEED. - 20 MIN DRILL TIME - REDDISH BROWN WATER & HOLDING - BIT BLOCKED.	TOP of ROCK ↗ SHALE, red-brown moderately hard fine grained, unweathered with slight weathering along scattered joints. Bedding dip 15°±.
56						
57.0	CORE BOX #1	NX	57.0 TO 59.9	RAN 2.9' REC. 2.9' 100%	DRILLED W/NX STANDARD BIT #91R7. HYD. FEED. 30 MIN. DRILL TIME. REDDISH BROWN WATER & HOLDING. BIT BLOCKED @ 59.9'.	
58						
59.9						
60						
61						

Site: PARK RIVER CONDUIT EXT HARTFORD, CONN.	Boring No. FD-5 P. #7-2	Page 5 of 6

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
61				RAN 5.0	DRILLED W/NX STANDARD BIT #91R7. HYD. FEED.	
	CORE BOX #1	NX	59.9 TO 64.9	REC. 4.6	49 MIN. DRILL TIME. REDDISH BROWN WATER HOLDING.	
63				100%	COMP. RUN @ 64.9'.	
64.9						
65				RAN 5.0	DRILLED W/NX STANDARD BIT #91R7 FROM 64.9' TO 69.9'. HYD. FEED.	
67	CORE BOX #2	NX	64.9 TO 69.9	REC. 5.0	51 MIN. DRIL TIME. REDDISH BROWN WATER 5' HOLDING.	
69				100%	COMP. RUN @ 69.9'	SANDSTONE red-brown. moderately hard fine grained unweathered Cross-bedded with varying dips.
69.9						
71				RAN 5.0	DRILLED W/ NX STANDARD BIT #91R7 FROM 69.9' TO 74.9'. HYD. FEED.	
	CORE BOX #2	NX	69.9 TO 74.9	REC. 3.9	52 MIN. DRIL TIME. REDDISH BROWN WATER 5' HOLDING.	
73				78%	COMP. RUN @ 74.9'.	
74.9					BOTTOM OF EXPLORATION @ 74.9'	
					DEPTH CONSIDERED SUFFICIENT.	

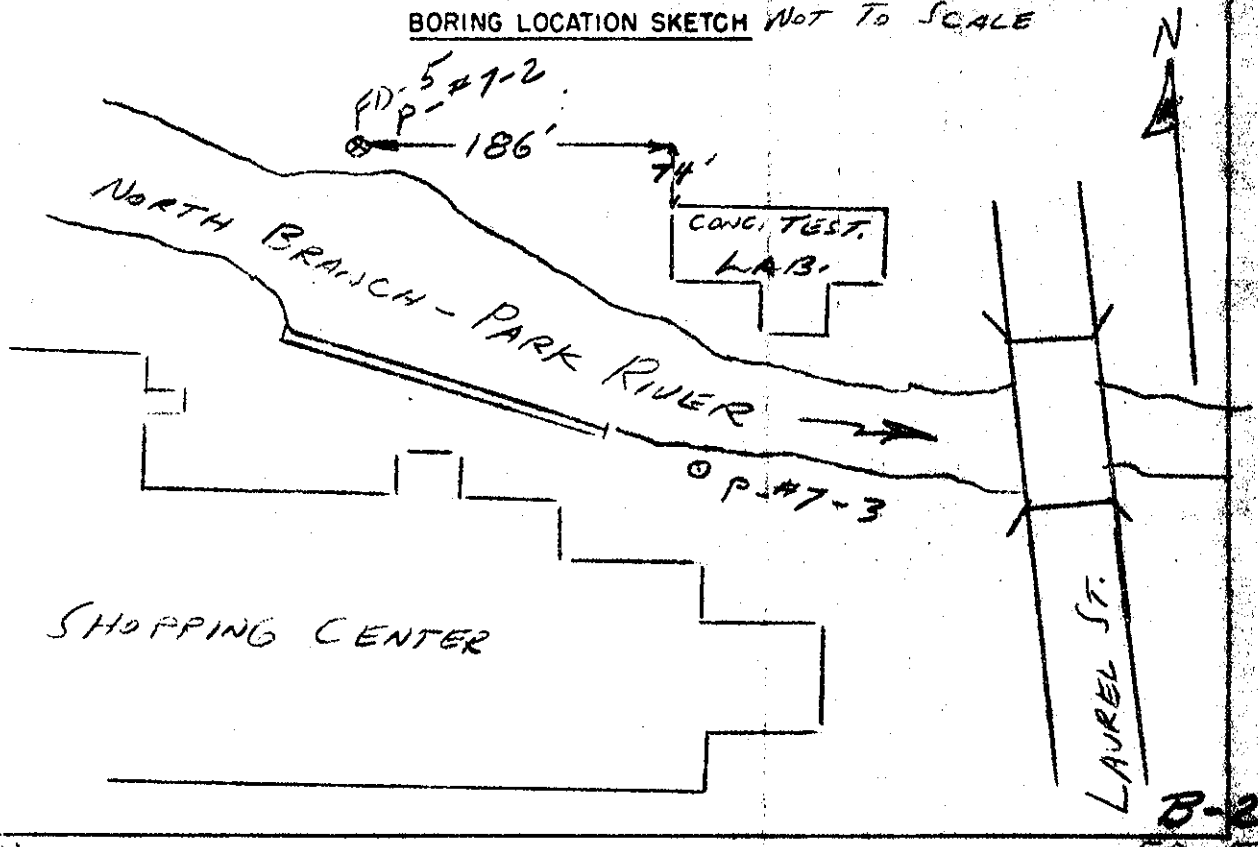
Site: HARTFORD, CONN.
Boring No: FD-5 P.#7-2

SUBSURFACE WATER OBSERVATIONS

DATE	TIME	DEPTH-BOT. OF CASING	DEPTH-BOT. OF BORING	DEPTH TO WATER	ELEVATION WATER	REMARKS
3/1	1600	10.5'	10.5'	0.0'	—	CSG FILLED W/ WATER - 1/4 HR READING
3/2	0900	10.0'	10.0'	0.0'	—	CSG PLUGGED
3/3	1600	35.0'	35.0'	5.4'	—	CSG FILLED - 1/4 HR READING
3/6	0900	35.0'	35.0'	11.0'	—	BEFORE DRILLING
3/6	1600	45.0'	45.0'	6.3'	—	CSG FILLED - 1/4 HR READING.
3/7	0900	45.0'	45.0'	9.6'	—	BEFORE DRILLING
3/9	0900	50.0'	52.2'	9.8'	—	" "
3/13	0900	50.0'	53.0'	9.0'	—	" "
3/13	1600	55.2'	57.0'	4.8'	—	CSG FILLED - 1/4 HR READING
3/14	0800	55.2'	57.0'	6.4'	—	BEFORE DRILLING
3/14	1600	55.2'	64.9'	1.3'	—	CSG FILLED - 1/4 HR READING
3/16	0900	55.2'	64.9'	7.3'	—	BEFORE DRILLING

Note: Depths are in feet below original ground

BORING LOCATION SKETCH NOT TO SCALE



B-22

CONN. 59 (Test)

Boring No. FD-5

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

Site Charles River Conduit Ext. Page 1 of 7 Pages

Hole No. FD-1 Sheet 1 of 1 Diam. (Casing) NX (6")

FIELD LOG OF TEST BORING

Co-ordinates: N 132,384 E 101,931

Elevation Top of Boring 454 M.S.L.
Total Overburden Drilled 89.6 Feet
Elevation Top of Rock — M.S.L.
Total Rock Drilled NONE Feet
Elevation Bottom of Boring -44.2 M.S.L.
Total Depth of Boring 89.6 Feet
Core Recovered — % No. Boxes 1
Core Recovered — Ft — Diam. — in.
Soil Samples 2½ in. Diam. 1 No.
Soil Samples 2 in. Diam. 3½ No.
NX

Hammer Wt. 350# Boring Started 9/14/52
Hammer Drop 18" Boring Completed 9/24/52
Casing Left NONE
Avg. Subsurface Water Depth — Elev. —
Obs. Well NONE (FINNERTY)
Drilled By U.S. ARMY CORPS OF ENGS.
Mfg. Des. Drill SH 40C #1
Inspected By: W. SWIFT & A. MERRILL
Classification By: [redacted]
Classification By: AMPLIFICATIONS BY LABORATORY CLASSIFIER [redacted]

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
0						
2	J1 (2 JARS)	2½"	0.0 5.0'	5 19 21 16 16	DROVE 2½" IDX5' SOLID SPOON FROM 0.0' TO 5.0' & TOOK SAMPLE. 100% RECY. HOLE OPEN TO 5.0'	Loose, reddish-brown, silty, clayey, gravelly, SAND, pieces of metal, coal and organics, moist (Fill)
4						
5.0'						
6				5 7	DROVE 2" IDX5' SOLID SPOON FROM 5.0' TO 10.0' & TOOK SAMPLE. 100% RECY.	
8	J2	2"	5.0 9.6'	6 6 9	JETTED NX FLUSH CASING FROM 0.0' TO 10.0'	
9.6'						Loose, brown, silty med. to fine SAND (SP) moist.
10.0	J3	2"	9.6			

GENERAL REMARKS: BORING LOCATED ON FILL AREA, AT TOP OF EMBANKMENT.

ED FORM 7-59 (Test) Boring No. FD-1

Site: PARK RIVER CONDUIT EXT. HARTFORD, CONN.

Boring No. FD-7

Page 1 of 1

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
11.1'	J4	2"	10.0' 11.1'	4	DROVE 2" ID X 5' SOLID SPOON FROM 10.0' TO 15.0' & TOOK SAMPLE.	same as above few pieces of gravel and wet.
12	J5 (2 JARS) B6	2"	11.1' 15.0'	7	100% REC'Y. JETTED NX FLUSH CASING FROM 10.0' TO 15.0'	Medium stiff, gray-brown, stratified layers of lean CLAY, (CL) moist
				16		
14				21		
15.0'				26		
16	J7 (2 JARS) B8	2"	15.0' 20.0'	1	DROVE 2" ID X 5' SOLID SPOON FROM 15.0' TO 20.0' & TOOK SAMPLE. 100% REC'Y. JETTED NX FLUSH CASING FROM 15.0' TO 20.0'	Soft, gray-brown, CLAY (CL), stratified w/thin layers of reddish fine sand moist.
				3		
18				3		
				4		
20.0'				6	DROVE 2" ID X 5' SOLID SPOON FROM 20.0' TO 25.0' & TOOK SAMPLE.	
22	J9 (2 JARS) B10	2"	20.0' 25.0'	WEIGHT OF TOOLS PLUS HAMMER	100% REC'Y. JETTED NX FLUSH CASING FROM 20.0' TO 25.0'	Soft, gray-brown, CLAY (CH), stratified with ¼ inch layers of gray SILT (ML), moist (Sample in jars sloughed, difficult to seperate SILT from CLAY)
24				6	DROVE 2" ID X 5' SOLID SPOON FROM 25.0' TO 30.0' & TOOK SAMPLE.	
25.0'				6		
26	J11 (2 JARS) B12	2"	25.0' 30.0'	WEIGHT OF TOOLS PLUS HAMMER	100% REC'Y. JETTED NX FLUSH CASING FROM 25.0' TO 30.0'	Soft, gray-brown, CLAY (CH), with thin layers of reddish fine SAND, moist. (clay- Wn = 68.9%)

FORM 58A (Test)

Boring No. FD-7

R-24

Site: A & P RIVER CONDUIT EXT. HARTFORD, CONN.

Boring No. FD-7

Page 3 of 7

DEPTH (ft)	CORE/SAMPLE NO.	CORE/SAMPLE SIZE	CORE/SAMPLE DEPTH	BLOWS PER FT. OR PRESSURE	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
28		2"	25.0' 30.0'	WEIGHT OF TOOLS PLUS HAMMER		
				3		
				4	DROVE 2" IDX5' SOLID SPOON FROM 30.0' TO	
30.0'					35.0' & TOOK SAMPLE.	Soft, reddish-brown, CLAY (CH), stratified with layers of gray-brown, SILT (ML) moist.
32	J13 (2 JARS) B14	2"	30.0' 35.0'	WEIGHT OF TOOLS PLUS HAMMER	JETTED NX FLUSH CASING FROM 30.0' TO 35.0'	
34				3	DROVE 2" IDX5' SOLID	
35.0'					SPOON FROM 35.0' TO 40.0' & TOOK SAMPLE.	
36					JETTED NX FLUSH CASING FROM 35.0' TO 40.0'	same as above
38	J15 (2 JARS) B16	2"	35.0' 40.0'	WEIGHT OF TOOLS PLUS HAMMER		
				6		
				5	DROVE 2" IDX5' SOLID	
40.0'					SPOON FROM 40.0' TO 45.0' & TOOK SAMPLE.	
42	J17 (2 JARS) B18	2"	40.0' 45.0'	WEIGHT OF TOOLS PLUS HAMMER	JETTED NX FLUSH CASING FROM 40.0' TO 45.0'	same as above (W_n = 60.9% CLAY) (W_n = 42.8% SILT) M.A.
				3		

Site: F. R. RIVER CONDUIT EXT. HARTFORD, CONN. | Boring No. FD-7 | Page 2 of 3

DEPTH	CORE/SAMPLE NO.	CORE/SAMPLE SIZE	CORE/SAMPLE DEPTH	BLOWS PER FT. OR PER REC'Y	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		2"	46.0 95.0	3	DROVE 2" ID X 5' SOLID	
45.0'				WEIGHT OF TOOLS	SPOON FROM 45.0' TO 50.0' & TOOK SAMPLE. 70% REC'Y.	
46					JETTED NX FLUSH CASING FROM 45.0' TO 50.0'	same as above
48	J19 (2 JARS) B20	2"	45.0 50.0	WEIGHT OF TOOLS PLUS HAMMER		
50.0'					DROVE 2" ID X 5' SOLID	
				WEIGHT OF TOOLS	SPOON FROM 50.0' TO 55.0' & TOOK SAMPLE. 100% REC'Y.	
52	J21 (2 JARS) B22	2"	50.0 55.0		JETTED NX FLUSH CASING FROM 50.0' TO 55.0	same as above
54				4	DROVE 2" ID X 5' SOLID	
55.0'					SPOON FROM 55.0' TO 60.0' & TOOK SAMPLE. 100% REC'Y.	
56	J23 (2 JARS) B24	2"	55.0 60.0	WEIGHT OF TOOLS PLUS HAMMER	JETTED NX FLUSH CASING FROM 55.0' TO 60.0'	same as above
58				10	DROVE 2" ID X 5' SOLID	
60.0'					SPOON FROM 60.0' TO 65.0' & TOOK SAMPLE.	
		2"	60.0 62.7	WEIGHT OF TOOLS		

Site: A. : RIVER CONDUIT EXT. HARTFORD, CONN.

Boring No. FD-7

Page 5 of 7

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH	BLOWS PER FT. OR PER SPEC. RECOV	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
F-2'				WEIGHT OF TOOLS PLUS HAMMER		
62	J25 (2 JARS)	2"	60.0 - 62.7		100% REC'Y. JETTED NX FLUSH CASING FROM 60.0' TO 65.0'	Same as above (wet)
62.7'						
64	J26 (2 JARS)	2"	62.7 65.0'	7 6 7	DROVE 2" ID X 5' SOLID	Soft, reddish-brown, gravelly, sandy, CLAY (CL), moist
65.0'						
66	J27 (2 JARS)	2"	65.0' 70.0'	7 7 17 47 87	SPOON FROM 65.0' TO 70.0' & TOOK SAMPLE. 100% REC'Y. JETTED NX FLUSH CASING FROM 65.0' TO 70.0' DROVE 2" ID X 5' SOLID SPOON FROM 70.0' TO 72.7' & TOOK SAMPLE.	same as above (soft to stiff)
70.0'						
72	J28 (2 JARS)	2"	70.0' 72.7'	45 121 224	REFUSAL @ 72.7' 100 BLOWS NO PENETRATION. ROTARY DIAMOND DRILLED NX "M" SERIES CORE BARREL FROM 72.7' TO 75.0' & TOOK SAMPLE.	same as above (stiff to very hard) M.A.
72.7'						
74	J29 (2 JARS)	NX	72.7' 75.0'		DRILLED NX FLUSH CASING FROM 70.0' TO 75.0' DROVE 2" ID X 5' SOLID SPOON FROM 75.0' TO 78.2' & TOOK SAMPLE.	same as above.
75.0'						
76	J30 (2 JARS)	2"	75.0 78.2	55 218 173	DISCONTINUED SAMPLING MATERIAL COMPACT. ROTARY DIAMOND DRILLED NX "M" SERIES CORE BARREL FROM 78.2' TO 80.4'	Very hard, reddish-brown, gravelly, silty-clayey, SAND (SM), moist (T.11)

Site: PA. RIVER CONDUIT EXT. HARTFORD, CONN.

Boring No. FD-7

Page 1 of 2

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
78.2'					DRILLED NX FLUSH CASING FROM 75.6 TO 80.4'	Compact to very Compact, reddish-brown, gravelly, sandy, SILT (ML), moist.
80	J31	NX "M"	78.2 80.4		DROVE 2" ID X 5' SOLID SPOON FROM 80.4' TO	
80.4'				22	84.0' & TOOK SAMPLE. DRILLED NX FLUSH	Compact to very compact reddish-brown, silty, clayey, gravelly, SAND (SM) moist (T.11)
				57	CASING FROM 80.4' TO 84.0'	
82	J32	2"	80.4 89.0	22	DROVE 2" ID X 5' SOLID SPOON FROM 84.0' TO 84.1' REFUSAL @ 84.1' 100 BLOWS NO PENETRATION.	
				225	ROTARY DRILLED NX "M" SERIES	
84.0'	J33					same as above
84.1'					CORE BARREL FROM 84.1' TO 89.0'	
86						Cobbles & Gravel
	Box #1	NX "M"	84.1 89.0		DROVE 2" ID X 5' SOLID SPOON FROM 89.0' TO 89.6' & TOOK SAMPLE.	
88					DISCONTINUED SAMPLING, COMPACT MAT'L.	
89.0'						
89.6'	J34	2"	89.0 89.6	166		same as S-32
					BOTTOM OF EXPLORATION @ 89.6' BOTTOM ELEVATION PREDETERMINED.	

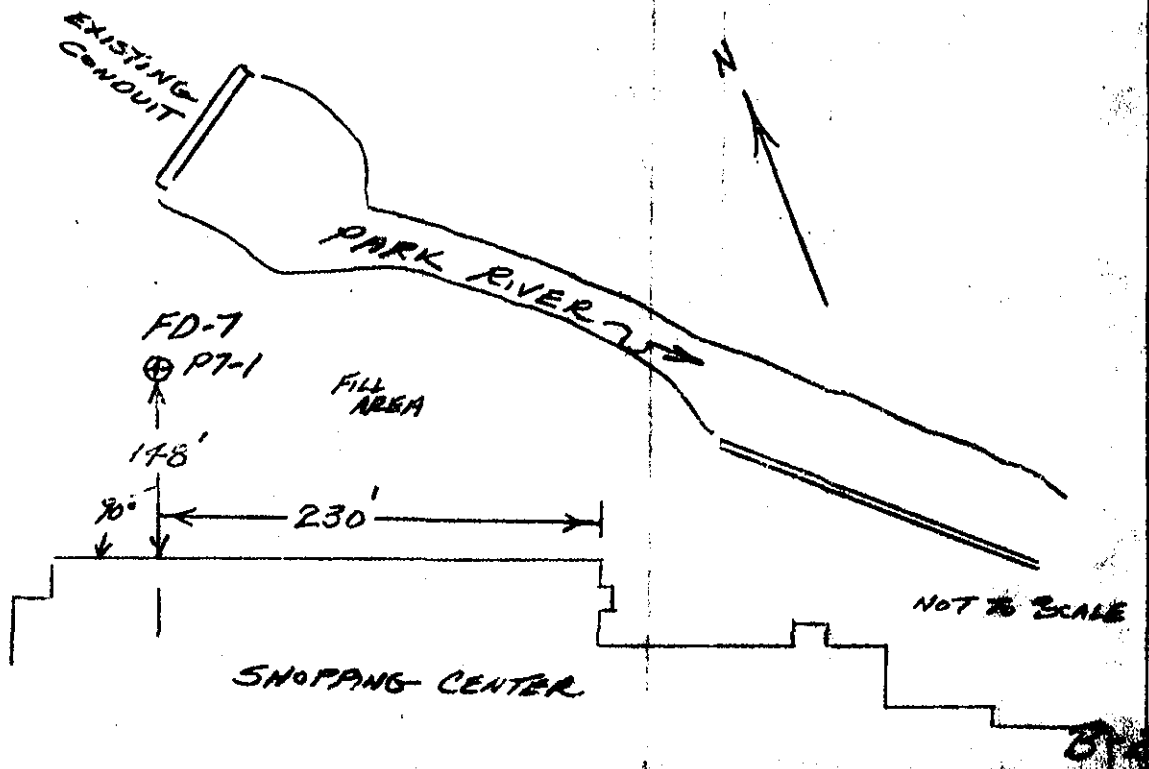
Site: PARK RIVER CONDUIT EXT. HARTFORD, CONN.
Boring No: FD-7

SUBSURFACE WATER OBSERVATIONS

DATE	TIME	DEPTH-BOT. OF CASING	DEPTH-BOT. OF BORING	DEPTH TO WATER	ELEVATION WATER	REMARKS
3/20	0800	45.0'	45.0'	10.6'		READING BEFORE DRILLING
3/20	1600	70.0'	72.7'	10.5'		READING 15 MIN. AFTER DRILLING
3/21	0900	70.0'	72.7'	10.5'		READING BEFORE DRILLING
3/23	0900	80.4'	80.4'	9.3'		READING BEFORE DRILLING
3/23	1500	85.0'	89.6'	14.6'		READING 15 MIN. AFTER DRILLING.

Note: Depths are in feet below original ground

BORING LOCATION SKETCH



B-89
FD-7

NED, [illegible] 59 (Test)

Boring No. FD-7

APPENDIX C

PROJECT COST AND ESTIMATES

TABLE C-1

ESTIMATED FIRST COST
(July 1974 Price Level)

SUMMARY

Non-Federal		
Lands and Damages	$	1,350,000
Relocations		950,000
Total non-Federal First Cost	$	2,300,000
Federal		
Pumping Stations	$	800,000
Conduit Extension		24,700,000
Auxiliary Conduit		36,500,000
Engineering & Design		4,900,000
Supervision & Administration		4,100,000
Total Federal First Costs	$	71,000,000
TOTAL FIRST COST	$	73,300,000

TABLE C-2

ESTIMATED TOTAL INVESTMENT
(3¼% Interest)

Federal		
First Cost	$	71,000,000
Interest During Construction (.05688)		4,038,000
Total Federal Investment	$	75,038,000
Non-Federal		
First Cost	$	2,300,000
Interest During Construction (.05688)		131,000
Total Non-Federal Investment		2,431,000
TOTAL INVESTMENT	$	77,469,000

TABLE C-3

ESTIMATED ANNUAL COSTS
(100-YEAR LIFE)
(3¼% Interest)

Federal		
Interest & Amortization on Investment (.03388 x $75,038,000)		$ 2,542,000
Non-Federal		
Interest & Amortization on Investment (.03388 x $2,431,000)	$ 82,000	
Major Replacements	12,000	
Maintenance & Operation	53,000	
Total Non-Federal		$ 147,000
TOTAL ANNUAL COSTS		2,689,000
TOTAL ANNUAL BENEFITS		3,392,400
BENEFIT-COST RATIO		1.3 to 1.0

TABLE C-4

DETAILED COST ESTIMATE
(July 1974 Price Level)

01. Lands and Damages

BOX CONDUIT

Nature of Interest	Acreage	Real Estate Costs
Permanent Easement or Fee	1.55	$120,000
Temporary Construction Easement	17.89	439,000
Total Acreage and Costs	19.44	$559,000

AUXILIARY CONDUIT

Nature of Interest	Acreage	Real Estate Costs
Permanent Easement or Fee	6.50	$166,000
Temporary Construction Easements	10.50	334,000
Total Acreage and Costs	17.00	$500,000
Total Real Estate Costs Rounded To		$1,050,000
Real Estate Owned by the Greater Hartford Flood Commission	9.50	300,000
Total - Lands and Damages	45.94	$1,350,000

02. Relocations

Conduit Extension

Replacement of:		
Broad Street	$ 49,000	
Flower Street	49,000	
Laurel Street	40,000	
Farmington Avenue	47,000	
Replace Street Drains	99,000	
Move 2-Car Garage - Lorraine St.	2,000	
Engineering and Design	17,000	
Supervision and Inspection	16,000	
Contingencies	64,000	
Sub-Total		$ 383,000

Auxiliary Conduit

Replacement of Streets	$210,000	
Replacement of Street Drains	115,000	
78" Sewer - Van Block Ave.	52,000	
78" Storm Drain - Van Block Ave.	47,000	
Engineering & Design	25,000	
Supervision & Inspection	24,000	
Contingencies	94,000	
Sub-Total		567,000
Total - Relocations		$ 950,000

	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
13.	Pumping Plants				
	Pope Park Pumping Station (Formerly Riverside Station)	1	Job	L.S.	$ 312,000
	Armory Pumping Station	1	Job	L.S.	355,000
					667,000
	Contingencies				133,000
					800,000
30.	Engineering and Design				64,000
31.	Supervision & Administration				53,000
	Total - Pumping Plants				$ 917,000
15.1	Conduit Extension				
	Preparation of Site	1	Job	L.S.	$ 15,000
	Removal of Bridges	1	Job	L.S.	100,000
	Removal of Buildings	1	Job	L.S.	50,000
	Prot. of Existing Str.	1	Job	L.S.	30,000
	Sandbags	1100	100 Bags	200.00	220,000
	Maint. & Control of Traffic	1	Job	L.S.	10,000
	25' Flume	660	L.F.	115.00	75,900
	25' Flume, Reused	3000	L.F.	50.00	150,000
	Excavation				
	Earth, General	237,200	c.y.	4.00	948,800
	Rock, Structure	16,300	c.y.	20.00	326,000
	Borrow & Place				
	Stone Protection	260	c.y.	25.00	6,500
	Processed Gravel	2550	c.y.	6.00	15,300
	Gravel Fill	600	c.y.	4.50	2,700
	Compacted Earth Fill	248,500	c.y.	3.00	745,500
	Pervious Fill	52,700	c.y.	4.00	210,800
	Conduit				
	Bearing Piles	33,100	L.F.	15.15	501,500
	Batter Piles	9,200	L.F.	20.00	184,000
	Piling, Steel Sheet, Walls	6,000	S.F.	12.00	72,000
	Piling, Steel Sheet, Constr.	54,400	S.F.	10.00	544,000
	Piling, Steel Sheet, Constr. Reused	12,400	S.F.	6.00	74,400
	Soldier Beams	4,700	L.F.	25.00	117,500
	Soldier Beams, Reused	8,700	L.F.	20.00	174,000
	Lagging, Wooden	41,000	S.F.	2.00	82,000
	Lagging, Wooden, Reused	45,000	S.F.	1.50	67,500

15.1 Conduit Extension (Cont'd)

Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
Struct. Steel Bracing	453,000	LB.	0.45	$ 203,900
Struct. Steel Bracing Reused	337,000	LB.	0.30	101,100
Earth Anchors	190	Ea.	800.00	152,000
Rock Anchors	400	Ea.	800.00	320,000
Concrete Conduit	68,900	c.y.	100.00	6,890,000
Concrete I-Walls	300	c.y.	140.00	42,000
Concrete T-Walls	1,000	c.y.	110.00	110,000
Concrete Spillway	240	c.y.	120.00	28,800
Concrete Fill	6,500	c.y.	50.00	325,000
Cement	505,000	CWT.	2.70	1,363,500
Steel Reinforcing	10,748,100	LB.	0.40	4,299,200
Drainage Facilities				
Temp. 24" Drain	300	L.F.	6.00	1,800
12" Drain Pipe	8,400	L.F.	4.00	33,600
High Level Storm Drains	1	Job	L.S.	352,000
Low Level Storm Drains	1	Job	L.S.	470,000
Trash Gate	1	Job	L.S.	12,000
Removal and replacement				
Sewer Line - Broad St.	1	Job	L.S.	8,000
Gas Lines	1	Job	L.S.	42,000
Electric Lines	1	Job	L.S.	800,000
Telephone Lines	1	Job	L.S.	740,000
Other Utilities	1	Job	L.S.	115,000
Topsoiling	87,000	S.Y.	2.00	174,000
Seeding	18	Ac.	2500.00	45,000
Landscaping	1	Job	L.S.	160,000
				21,512,300
Contingencies				3,187,700
				24,700,000
30. Engineering & Design				1,970,000
31. Supervision & Administration				1,630,000
Total - Conduit Extensions				$28,300,000

Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
15.2 Auxiliary Conduit				
Preparation of site	1	Job	L.S.	$ 20,000
Main. & Control of traffic	1	Job	L.S.	100,000
Control of water	1	Job	L.S.	200,000
Protection & repairs to existing Structures	1	Job	L.S.	750,000
Removal of Bldgs.	1	Job	L.S.	10,000
Excavation				
Earth, common	5,000	c.y.	3.00	15,000
Earth, structure	63,000	c.y.	4.00	252,000
Earth, tunnel	28,000	c.y.	75.00	2,100,000
Rock, structure	26,000	c.y.	20.00	520,000
Rock, tunnel	145,000	c.y.	38.00	5,510,000
Borrow				
Pervious	28,000	c.y.	4.00	112,000
Gravel	2,000	c.y.	4.50	9,000
Placing				
Random backfill	24,000	c.y.	2.00	48,000
Pervious backfill	28,000	c.y.	2.00	56,000
Gravel	2,000	c.y.	2.00	4,000
Furnishing and driving steel sheet piling, incl. bracing	26,000	S.F.	13.70	356,200
Slurry trench, reinforced	185,000	C.F.	10.40	1,924,000
Bearing piles, steel	18,000	L.F.	15.15	272,700
Tunnel support steel				
Tunnel in rock	4,500,000	LBS.	0.65	2,925,000
Tunnel in earth	1,500,000	LBS.	0.65	975,000
Rock bolts	25,000	L.F.	9.50	237,500
Steel lagging	40,000	L.F.	5.00	200,000
Liner plate - tunnel in earth	1,100,000	LBS.	0.65	715,000
Concrete, mass	3,000	c.y.	70.00	210,000
Concrete, reinforced				
Tunnel in earth	10,000	c.y.	133.00	1,330,000
Conduit in open cut	20,000	c.y.	133.00	2,660,000
Concrete, tunnel lining	60,000	c.y.	94.00	5,640,000
Grout, tunnel rock	1	Job	L.S.	237,000

Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
15.2 Auxiliary Conduit (Cont'd)				
Removal and replacement:				
Water lines, sewer lines, & drainage facilities	1	Job	L.S.	1,150,000
Electrical lines	1	Job	L.S.	900,000
Telephone lines	1	Job	L.S.	700,000
Gas lines	1	Job	L.S.	50,000
Railroad track	1	Job	L.S.	100,000
Cofferdam	1	Job	L.S.	150,000
Seeded Topsoil	5,000	S.Y.	2.50	12,500
				30,450,900
Contingencies				6,049,100
				36,500,000
30. Engineering & Design				2,900,000
31. Supervision & Administration				2,400,000
Total - Auxiliary Conduit				$41,800,000
TOTAL PROJECT FIRST COST				$73,300,000